



208767

# TREATABILITY STUDY REPORT SAUGET AREA 2 INTERIM GROUNDWATER REMEDY

Prepared for:



**SOLUTIA INC.**

Sauget, Illinois

Prepared by:



THE **ADVENT** GROUP, INC.

October 2003

Innovative solutions to environmental challenge



**Solutia Inc.**  
W.G. Krummrich Plant  
500 Monsanto Avenue  
Sauget, Illinois 62206-1198  
Tel 618-271-5835

November 13, 2003

Mr. Nabil S. Fayoumi  
U. S. Environmental Protection Agency - Region 5  
Superfund Division  
77 West Jackson Boulevard (SR-6J)  
Chicago, Illinois 60604-3590

**Re: Groundwater Treatability Study Report  
Groundwater Migration Control System  
Sauget Area 2 – Sites O, Q, R And S  
Sauget, Illinois**

Dear Mr. Fayoumi:

Attached to this letter are three copies of a report that summarizes the results of the groundwater treatability test that was performed at Site R in May 2003. This report is being submitted to your for your information.

If you have any questions about the attached document please do not hesitate to call me.

Sincerely,  
Solutia Inc.

*Gary W. Vandiver for Richard Williams*

Gary W. Vandiver  
Project Coordinator

cc: Ken Bardo - USEPA  
Sandra Bron - IEPA  
Tim Gouger - USACE  
Mike Coffey - USF&W  
Peter Barrett - CH2M Hill

Richard Williams - Solutia  
Linda Tape - Husch & Eppenberger  
Cathy Bumb - Solutia  
Bruce Yare - Solutia



THE ADVENT GROUP, INC.

October 30, 2003

Mr. Richard Williams  
Sauget Sites Project Manager  
Solutia Inc.  
500 Monsanto Avenue  
Sauget, IL 62206-1198

**Subject: Treatability Study Report – Sauget Area 2 Interim Groundwater Remedy  
ADVENT Project 02689**

Dear Mr. Williams:

Please find attached 20 copies of the report titled, *Treatability Study Report – Sauget Area 2 Interim Groundwater Remedy*. We have enjoyed working with you on this project and look forward to working with you in the future.

Should you have questions regarding this report, please do not hesitate to call us.

Sincerely,

The ADVENT Group, Inc.

Todd Lusk  
Project Engineer

  
Janet B. Egli, P.E.  
Project Manager  
Carl E. Adams, Jr., P.E., Ph.D.  
President

cc: Bruce Yare

# **TREATABILITY STUDY REPORT SAUGET AREA 2 INTERIM GROUNDWATER REMEDY**

Prepared for:



**SOLUTIA INC.**

Sauget, Illinois

Prepared by:



The ADVENT Group, Inc.  
201 Summit View Drive, Suite 300  
Brentwood, TN 37027

October 2003

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<u>Attachment No.</u>	<u>Title</u>
1	American Bottoms Regional Treatment Facility Temporary User Discharge Permit
2	ASTM Method D6586 - Performing Rapid Small-Scale Column Test



## **1.0 INTRODUCTION AND BACKGROUND**

### **1.1 INTRODUCTION**

In accordance with the Administrative Order for Remedial Design and Interim Remedial Action (Docket No. V-W-02-C-716), issued by USEPA Region 5 on October 3, 2002, a Remedial Design for a Groundwater Migration Control System is being prepared that consists of a 3,300 ft. long, U-shaped barrier wall and three groundwater extraction wells installed on the upgradient side of the barrier wall. This Groundwater Migration Control System is being installed to control the discharge of impacted groundwater to surface water downgradient of Sauget Area 2 Sites O, Q (Dog Leg), R and S; Sauget Area 1 Sites G, H I and L; the W.G. Krummrich plant, and other industrial facilities in the Sauget Area.

In preparation for the eventual collection and discharge of the Site R groundwater to ABRTF, Solutia authorized the drilling and development of one of the recovery wells at the site. The development and testing of the well was conducted during May 2003, with the groundwater being discharged to ABRTF. ABRTF issued a temporary user discharge permit to Solutia to allow the discharge of carbon treated groundwater to their treatment facility. Accordingly, Solutia contracted ADVENT to oversee the installation and operation of an activated carbon treatment system. The full-scale pump test also served as a means to collect representative characterization data for the groundwater aquifer and to establish carbon usage rates while determining the effectiveness of GAC treatment of this groundwater.

### **1.2 PROJECT OBJECTIVES**

In preparation for the execution of the pilot system and bench-scale treatability tests described above, ADVENT prepared and submitted a Work Plan to Solutia outlining the methods to be used during the study. These objectives were as follows:

- Install and operate a pilot-scale activated carbon system capable of treating 200 gpm;
- Generate and analyze characterization data to determine the composition of the groundwater;

- Determine the projected carbon usage rate for a full-scale GAC treatment system;
- Treat and discharge the water associated with the development of the first collector well through the pilot system;
- Determine the effectiveness of ozone as a pretreatment or post-treatment technology to be coupled with activated carbon; and,
- Operate the pilot system within the constraints specified in the ABRTF temporary user discharge permit

### **1.3 PERMIT REQUIREMENTS**

A copy of the temporary user discharge permit is included in Attachment 1. This permit included limits on a wide variety of compounds, including but not limited to the following:

- Ammonia nitrogen ( $\text{NH}_3\text{-N}$ );
- Volatile organic compounds (VOCs);
- Semi-volatile organic compounds (SVOCs);
- Pesticides and PCBs;
- Metals; and,
- Cyanide.

A discussion of the details of sample collection and analytical methods for permit compliance is included in Section 2.4.

**2**

## **2.0 PROJECT APPROACH**

### **2.1 PILOT SYSTEM DESIGN**

In order to produce an accurate model of the previously developed design for full-scale backup activated carbon treatment system for the Site R groundwater, ADVENT designed the pilot system to achieve a hydraulic loading of 3-4 gpm/ft<sup>2</sup>. A flow rate of 200 gpm was selected for the study to provide representative groundwater characterization data and simulate the full-scale application. A minimum surface area of 50 sq ft was required to meet the desired hydraulic loading rate. A copy of the preliminary process design for the pilot system is included in Table 2-1.

ADVENT solicited input from various activated carbon equipment vendors and ultimately selected the Calgon Mobile Adsorber as the equipment for use in the pilot system. The Mobile Adsorber is an 8-ft diameter vessel containing approximately 12,000 lb of activated carbon, and these units can be rapidly mobilized and transported to a site. For this study, Calgon DSR-C was chosen as the activated carbon for study. DSR-C is an 8x30 mesh reactivated granular carbon commonly used in groundwater and wastewater treatment applications. This carbon will most likely be selected for the full-scale system due to its cost-effectiveness for this type of application.

In order to replicate the design of the backup full-scale system, two Mobile Adsorbers were placed in a lead-lag configuration. This configuration provided the ability to establish a breakthrough curve for the influent groundwater (lead column), while providing permit compliance (lag column). Breakthrough was defined as an effluent Chemical Oxygen Demand (COD) concentration equal to or greater than 50 percent of the influent concentration. A process flow diagram of the pilot system is shown in Figure 2-1. The monitoring sample locations are described in Section 2.4.

### **2.2 BENCH SCALE TREATABILITY DESIGN**

In addition to the pilot-scale GAC treatment, ADVENT concurrently designed and executed several bench-scale treatability tests for the Area 2 groundwater. These tests were performed in order to help predict the performance of the pilot system and to

determine the effectiveness of additional treatment technologies in reducing the carbon usage rate.

The first bench-scale test conducted was a Rapid Small-Scale Column Test (RSSCT) per ASTM D6586. A copy of the ASTM method is included in Attachment 2. The RSSCT method was designed to serve as a means of quickly establishing the breakthrough curve anticipated for a full-scale system. The RSSCT tests conducted at the site were designed based on the parameters of the pilot system. The preliminary process design used for this test is shown in Table 2-2. The expected run time of the pilot system was established using the effluent COD concentration to define breakthrough. Comparisons of the RSSCT results and pilot system results is provided in Section 5.2.

Ozonation was evaluated as supplemental treatment technology for the Area 2 groundwater. Samples of both the influent and lag column effluent from the pilot system were subjected to ozone treatment to determine the effectiveness of ozone as a pretreatment of polishing technology for GAC. Analytical results from the ozonation of the influent were used to estimate carbon usage rates based on an ozone pretreatment, and results from the effluent ozonation were analyzed to determine if the ozonated water achieved ambient water quality criteria. The preliminary process design for the influent bench-scale ozone test is provided in Table 2-3, and a schematic of the treatability unit designed for ozone testing is shown in Figure 2-2.

### **2.3 WELL DEVELOPMENT WATER TREATMENT**

Prior to startup of the pilot system, one of the three proposed collector wells was drilled and developed to provide the groundwater influent for treatment. The initial surge of groundwater (i.e., the development water) from the well pump was expected to contain a high level of suspended solids that would negatively impact performance of the GAC. Thus, this water was diverted to a 250,000-gallon modular tank. Once breakthrough of the pilot system lead column was observed, the well pump was shut down. The system was then reconfigured so that the lag column of the pilot system functioned as the lead column during development water treatment. A third Mobile Adsorber was placed in

operation as the new lag column. This reconfiguration was performed in order to offer the maximum level of treatment and permit compliance.

## 2.4 SAMPLING AND ANALYTICAL PLAN

Data were collected throughout the operation of the study for multiple purposes, including the following:

- Characterization of raw groundwater;
- Determination of the breakthrough curve for the lead column of the pilot system for TOC and key individual parameters;
- Comparison of the RSSCT and pilot systems;
- Determination of the effectiveness of ozone as a pre and post treatment technology; and,
- Demonstration of compliance with permit limits.

For the pilot system, samples were collected and analyzed at three locations.

- Point A represents influent groundwater to the pilot system, as well as untreated development water during the development water treatment;
- Point B represents the effluent from the lead column of the pilot system; and,
- Point C represents the effluent from the lag column. This was also the point of sampling to demonstrate compliance. Samples for onsite analysis were collected every two hours of operation, while samples for offsite analysis were collected every six hours.

A complete sampling matrix for the pilot system, including sampling frequency, is shown in Table 2-4. Samples of influent and effluent from each bench-scale treatability test were collected and analyzed.

The following parameters were measured on site by ADVENT operators:

- Flow;
- pH;

- Temperature;
- Conductivity;
- Total suspended solids (TSS); and,
- Chemical oxygen demand (COD).

The following parameters were analyzed by various contract laboratories:

- Total organic carbon (TOC);
- Volatile and semi-volatile organic constituents (VOCs and SVOCs);
- Dioxins;
- PCBs;
- Metals (including mercury);
- Cyanide;
- Herbicides; and,
- Pesticides.

Samples for dioxin analyses were shipped to Severn Trent Laboratories in Sacramento, CA. All other offsite samples were shipped to Severn Trent Laboratories in Savannah, GA. A complete listing of the analytical methods used on these samples is included in Table 2-5.

Compliance demonstration samples were collected and delivered to ABRTF for compositing and analysis. Cyanide samples were the lone exception to this compliance sampling, and these samples were analyzed by the Savannah laboratory.

**TABLE 2-1. GAC TREATMENT OF SITE R PUMP TEST GROUNDWATER  
PRELIMINARY PROCESS DESIGN - PILOT-SCALE SYSTEM**

PARAMETER	UNITS	VALUE	COMMENTS
<b>DESIGN BASIS</b>			
Influent			
Design Flow	gpm	200	
	mgd	0.29	
TSS	mg/L	12	Assumed for design
	lb/d	29	
TOC	mg/L	300	Average Concentration from 1992
	lb/d	720	Used for Design
<b>ACTIVATED CARBON REQUIREMENTS</b>			
Activated Carbon System			
Design Hydraulic Loading Rate	gpm/ft <sup>2</sup>	3	
Total Carbon Area Required	ft <sup>2</sup>	67	Based on design flow
Columns			
Carbon Bed Height	ft	9	
Column Diameter (Each)	ft	8	Calgon Mobile Adsorbers
Surface Area Per Column	ft <sup>2</sup>	50.3	
Number of Columns Required	--	1.3	
Number of Columns Provided	--	1	
Surface Area Provided	ft <sup>2</sup>	50.3	
Actual Hydraulic Loading Rate	gpm/ft <sup>2</sup>	4.0	
Contact Time	min	33.8	
Lead Carbon per Column	lb	12,000	
Total Lead Carbon Charge	lb	12,000	
Carbon Demand			
Carbon Capacity	g TOC/g carbon	0.15	To be confirmed during test
Design Flow			
Estimated Carbon Usage	ton/d	2.4	
Estimated Run Time	days	2.5	Assumes complete exhaustion

**TABLE 2-2. GAC TREATMENT OF SITE R PUMP TEST GROUNDWATER  
PRELIMINARY PROCESS DESIGN - RAPID-SCALE SYSTEM (RSSCT)**

PARAMETER	UNITS	VALUE		COMMENTS
		RSCCT	PILOT	
<b>DESIGN BASIS</b>				
Column Diameter	cm	1	243.8	
Carbon Particle Radius	mm	0.106	0.792	
Empty Bed Contact Time	min	0.30	16.9	
Hydraulic Loading Rate	gpm/ft <sup>2</sup>	29.74	3.98	
Required Time to Breakthrough	days	0.104	5.80	To Determine Pilot Breakthrough Curve With 20% safety factor
Run Time	hr	0.125 2.99		
<b>RSSCT REQUIREMENTS</b>				
Column Cross-section	ft <sup>2</sup>	0.00102	50.3	
Flow	gpm	0.0304	200	
Flow	mL/min	115.14		
Bed Volume	mL	34.85		
Bed Depth	cm	36.68		
Influent Required Per Test	gal	5.46		
Influent Required Per Test	L	20.67		

**TABLE 2-3. OZONE TREATMENT OF SITE R PUMP TEST GROUNDWATER  
PRELIMINARY PROCESS DESIGN - BENCH-SCALE SYSTEM**

PARAMETER	UNITS	VALUE	COMMENTS
<b>DESIGN BASIS</b>			
Influent			
Sample Volume	L gal	15 4.01	Set for analytical requirements
TSS	mg/L	12	Assumed for design
TOC	mg/L	300	Average Concentration from 1992
COD	mg/L	900	Assumed 3:1 COD:TOC ratio
<b>OZONE TREATMENT REQUIREMENTS</b>			
Ozone Generator			
Air flow	scfh	10	
Ozone Generation Rate	mg/hr	1,500	Vendor information
Ozone Requirements	mg O <sub>3</sub> / mg COD	3	Set for design
Required Run Time	min hours	1,620 27.0	

TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS

SAMPLE TIME			ONSITE BY ADVENT					OFFSITE TO ABRTF <sup>(a)</sup>					
Day	Time	Run Time	pH	Temp	Cond	COD	TSS	VOCs	SVOCs	Metals	PCBs	Pest.	Herb.
1	12:00	0	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	14:00	2	A, B, C	A, B, C	A, B, C	A, B							
	16:00	4	A, B, C	A, B, C	A, B, C	A, B							
	18:00	6	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	20:00	8	A, B, C	A, B, C	A, B, C	A, B							
	22:00	10	A, B, C	A, B, C	A, B, C	A, B							
	0:00	12	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	2:00	14	A, B, C	A, B, C	A, B, C	A, B							
2	4:00	16	A, B, C	A, B, C	A, B, C	A, B							
	6:00	18	A, B, C	A, B, C	A, B, C	A, B	A, B						
	8:00	20	A, B, C	A, B, C	A, B, C	A, B							
	10:00	22	A, B, C	A, B, C	A, B, C	A, B							
	12:00	24	A, B, C	A, B, C	A, B, C	A, B	A, B						
	14:00	26	A, B, C	A, B, C	A, B, C	A, B							
	16:00	28	A, B, C	A, B, C	A, B, C	A, B							
	18:00	30	A, B, C	A, B, C	A, B, C	A, B	A, B						
	20:00	32	A, B, C	A, B, C	A, B, C	A, B							
	22:00	34	A, B, C	A, B, C	A, B, C	A, B							
	0:00	36	A, B, C	A, B, C	A, B, C	A, B	A, B						
	2:00	38	A, B, C	A, B, C	A, B, C	A, B							
3 <sup>(c)</sup>	4:00	40	A, B, C	A, B, C	A, B, C	A, B							
	6:00	42	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	8:00	44	A, B, C	A, B, C	A, B, C	A, B							
	10:00	46	A, B, C	A, B, C	A, B, C	A, B							
	12:00	48	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	14:00	50	A, B, C	A, B, C	A, B, C	A, B							
	16:00	52	A, B, C	A, B, C	A, B, C	A, B							
	18:00	54	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	20:00	56	A, B, C	A, B, C	A, B, C	A, B							
	22:00	58	A, B, C	A, B, C	A, B, C	A, B							
	0:00	60	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	2:00	62	A, B, C	A, B, C	A, B, C	A, B							

TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS

SAMPLE TIME			ONSITE BY ADVENT					OFFSITE TO ABRTF <sup>(a)</sup>					
Day	Time	Run Time	pH	Temp	Cond	COD	TSS	VOCs	SVOCs	Metals	PCBs	Pest.	Herb.
4-6	4:00	64	A, B, C	A, B, C	A, B, C	A, B	A, B						
	6:00	66	A, B, C	A, B, C	A, B, C	A, B							
	8:00	68	A, B, C	A, B, C	A, B, C	A, B							
	10:00	70	A, B, C	A, B, C	A, B, C	A, B							
	12:00	72	A, B, C	A, B, C	A, B, C	A, B	A, B						
	14:00	74	A, B, C	A, B, C	A, B, C	A, B							
	16:00	76	A, B, C	A, B, C	A, B, C	A, B							
	18:00	78	A, B, C	A, B, C	A, B, C	A, B	A, B						
	20:00	80	A, B, C	A, B, C	A, B, C	A, B							
	22:00	82	A, B, C	A, B, C	A, B, C	A, B							
	0:00	84	A, B, C	A, B, C	A, B, C	A, B	A, B						

**TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS**

SAMPLE TIME			OFFSITE TO SEVERN TRENT LABORATORIES <sup>(b)</sup>								
Day	Time	Run Time	CN <sup>a</sup>	VOCs	SVOCs	Metals	TOC	PCBs	Pest.	Herb.	Dioxins
1	12:00	0	A, C	A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	2									
	16:00	4									
	18:00	6		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	8									
	22:00	10									
	0:00	12		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	2:00	14									
2	4:00	16									
	6:00	18		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	8:00	20									
	10:00	22									
	12:00	24		A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	26									
	16:00	28									
	18:00	30		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	32									
	22:00	34									
	0:00	36		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	2:00	38									
3 <sup>(c)</sup>	4:00	40	A, C								
	6:00	42		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	8:00	44									
	10:00	46									
	12:00	48		A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	50									
	16:00	52									
	18:00	54		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	56									
	22:00	58									
	0:00	60		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	2:00	62									

**TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS**

SAMPLE TIME			OFFSITE TO SEVERN TRENT LABORATORIES <sup>(b)</sup>								
Day	Time	Run Time	CN <sup>a</sup>	VOCs	SVOCs	Metals	TOC	PCBs	Pest.	Herb.	Dioxins
4-6	4:00	64		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	6:00	66		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	8:00	68		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	10:00	70		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	12:00	72		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	14:00	74		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	16:00	76		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	18:00	78		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	80		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	22:00	82		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	0:00	84		A, B	A, B	A, B	A, B	A, B	A, B	A, B	

Notes:

- (a) Sampling for ABRTF shall consist of 5 VOA vials for VOC analysis and a common jug for all other analyses  
(b) Dioxins shipped to STL Sacramento, all other parameters sent to STL Savannah

Location A - Pilot Influent

Location B - Lead Column Effluent

Location C - Lag Column Effluent

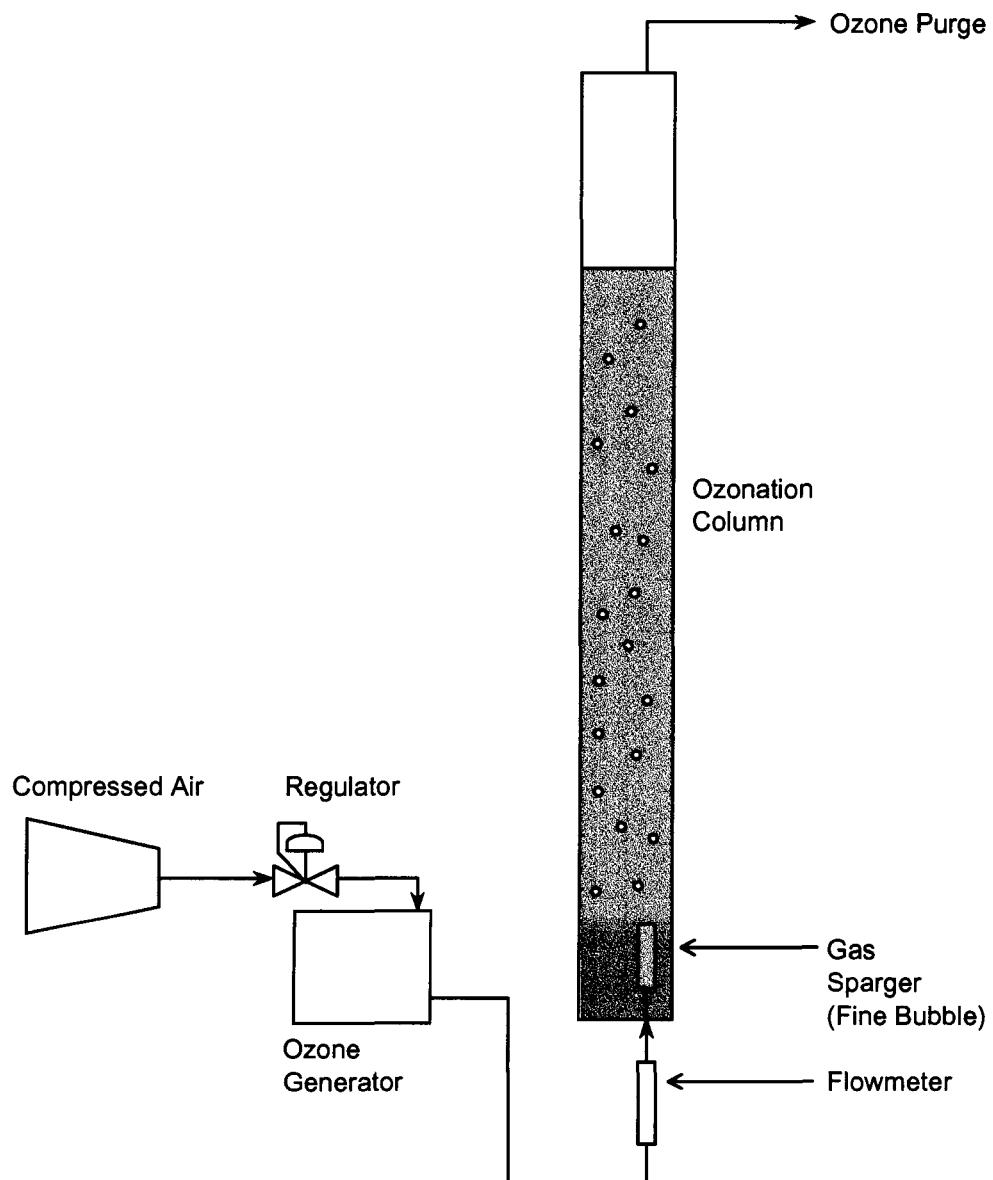
**TABLE 2-5. ANALYTICAL METHODS**

PARAMETER	ANALYST	METHOD	REFERENCE
pH	ADVENT	4500	Standard Methods <sup>(a)</sup>
Conductivity	ADVENT	2510	Standard Methods <sup>(a)</sup>
Temperature	ADVENT	2550	Standard Methods <sup>(a)</sup>
Chemical Oxygen Demand (COD)	ADVENT	8000	Hach Handbook <sup>(b)</sup>
Herbicides	Contract Lab	615	EPA
PCBs	Contract Lab	680	EPA
Dioxin	Contract Lab	1613	EPA
Metals	Contract Lab	200.7	EPA
Mercury	Contract Lab	245.1	EPA
Cyanide, total	Contract Lab	335.2	EPA
Total Organic Carbon (TOC)	Contract Lab	415.1	EPA
Volatile Organics (VOCs)	Contract Lab	624	EPA
Semivolatile Organics (SVOCs)	Contract Lab	625	EPA
Pesticides	Contract Lab	608	EPA

Notes:

(a) *Standard Methods for the Examination of Water and Wastewater*, 19th Edition, APHA-AWWA-WPCF, 1995.(b) *Water Analysis Handbook*, HACH Company, 1997.

## **FIGURE 2-1. BENCH-SCALE OZONE TREATABILITY APPARATUS**





### **3.0 SYSTEM OPERATION**

#### **3.1 MOBILIZATION AND STARTUP**

The components of the pilot system were delivered and assembled during the week of May 12, 2003. Calgon delivered two Mobile Adsorbers to the project site via hydraulic lift trailers, and the columns were placed onsite adjacent to the storage building and project trailer. Once the columns were set, potable water was supplied to the units via a 1 inch hose in order to wet the carbon and remove any entrained air. Sample ports were constructed using steel pipe spools with ½ inch copper pipe taps and ½ inch ball valves. Connections to and from the 6 inch PVC header pipe from the collector well were made using 4 inch flexible hose with Kamlock style quick-connect couplings.

Immediately before startup of the pilot system, the well pump was activated and water was diverted to the modular tank to flush collected solids from the line. After several minutes of flushing, the flow was shut off and the valves on the header pipe were operated to direct flow to the pilot system. Flow was then restarted and slowly increased to the target rate of 200 gpm. Flow through the system was measured through two magnetic flowtubes located on the 6 inch header pipe. The first sampling event occurred at 12:00 PM on May 19, 2003.

Several characteristics of the influent groundwater were noted and recorded during the study. First, the influent samples taken at Point A exhibited a noticeable odor, described as similar to formaldehyde or phenol. As the carbon in the lead column became exhausted, this odor was detected in samples at Point B as well. Second, the collected samples would become colored reddish-brown and cloudy after exposure to air and light for several hours, with samples from Point A exhibiting the most drastic changes. Analytical results, as will be discussed in Chapter 4, later confirmed that this color and turbidity change were likely due to the presence of iron in the groundwater. Weakly colored ferrous iron from the aquifer ( $Fe^{2+}$ ) oxidizes after prolonged exposure to air and will result in the formation of the reddish-brown ferric iron ( $Fe^{3+}$ ).

## **3.2 PILOT SYSTEM OPERATIONS**

The pilot system ran from 12:00 p.m. on May 19 to 10:00 a.m. on May 24, 2003. During operations, two ADVENT operators remained onsite around the clock to record operating parameters, conduct bench-scale tests, and collect and ship samples for analysis. Operators conducted a walkthrough of the system every two hours to measure parameters and collect the necessary samples as outlined in Table 2-4. In addition, Mr. Robert Mooshegian of Golder and Associates was the site certified Class K wastewater operator of the system. Mr. Mooshegian was onsite or on call throughout the study.

### **3.2.1 Flow**

Flow to the pilot system was controlled using a gate valve located near the well pump. ADVENT operators recorded both the instantaneous and totalized flow as part of each walkthrough. Due to the gradual buildup of solids and potential wear on the pump impeller, the flow gradually decreased over the course of operations. When the flow dropped below 190 gpm, the valve at the well pump was adjusted to return the flow to the target rate of 200 gpm. Towards the end of the test, the buildup of suspended solids in the lead column caused the flow to drop below 190 gpm, even with the gate valve in the fully open position. The recorded flow to the pilot system is shown in Table 3-1 and presented graphically in Figure 3-1. The sharp increases in flow on Figure 3-1 correspond to the instances when the gate valve at the well pump was actuated to increase flow.

### **3.2.2 Pressure**

After approximately 6 hours of operation, pressure gauges were installed on the influent and effluent lines of the lead column in order to monitor the operating pressure of the lead column and the differential pressure across the carbon bed. The onsite Calgon Carbon Representative requested that the operation be ceased if the lead carbon column operating pressure exceeded 35 psig. Any increase in differential pressure would indicate a buildup of suspended solids in the carbon bed and would also cause a decrease in flow, as was observed. After installation of the pressure gauges, ADVENT operators monitored the pressure across the lead column as part of their bi-hourly

walkthrough. The lead and lag column pressures were initially 17 and 12 psig, respectively, resulting in a differential pressure of 5 psig. The operating pressure of the two columns gradually increased throughout the test period. However, the delta pressure remained fairly constant until approximately 68 hours of operation. At that time, the operating pressures of the two columns were 22.5 and 15.5 psig. The lead column pressure continued to rise, while the lag column operating pressure remained steady then slightly decreased. The operating pressure of the lead column had reached 29 psig with a differential pressure of 15 psig when the system was shutdown after 118 hours of operation. Pressure data recorded on the pilot system are also included in Table 3-1 and shown on Figure 3-2.

### **3.3 TREATABILITY UNIT OPERATIONS**

Equipment for the bench-scale treatability units was transported to the site from the ADVENT laboratory in Nashville, Tennessee by ADVENT personnel, along with other equipment necessary for operations and onsite analyses. Treatability tests were conducted during the operation of the pilot system. Where possible, influent samples for the bench-scale tests were collected immediately after a six-hour sampling event so that the analytical results from the pilot system sampling would correspond to the influent characteristics of the bench-scale study.

#### **3.3.1 Rapid Small-Scale Column Test**

Two RSSCT units were operated during the study. The first test was conducted to determine an estimated breakthrough time of the pilot system. To accomplish this, effluent samples were collected at 10-minute intervals for three hours and analyzed for COD. The results of this analysis are shown in Table 3-2 and will be discussed in Sections 4.2 and 5.2. Once a tentative breakthrough curve had been established, a second column study was conducted to generate sufficient treated effluent for a full analytical scan comparable to analyses required for permit compliance as shown in Table 2-4.

### **3.3.2 Ozonation Tests**

The ozone tests were conducted to determine the effectiveness of ozonation as both a pretreatment and post-treatment technology in series with activated carbon. To accomplish this, batch ozone testing was conducted on samples taken at Point A (lead column influent) and Point C (lag column effluent). Each test consisted of 15 L of influent placed in a 6 inch vertical column and subjected to 1500 mg/hr of ozone at an air flow rate of 10 scfh. A compressed air cylinder supplied the feed to the ozone generator. The ozone-enriched air was then introduced into the bottom of the reactor via a ceramic air sparger. The duration of each test was determined based on the influent COD, and the water was subjected to ozonation for a period long enough to provide 3 mg of ozone per mg of COD. During operation of the ozone tests, the reddish-brown color observed in the analytical samples appeared rapidly and was far more pronounced, providing additional evidence that the color change was likely due to the oxidation of ferrous iron.

### **3.4 DEVELOPMENT WATER TREATMENT OPERATIONS**

After completion of the pilot system testing, the remaining water in the columns was purged from the system with an air compressor by closing the inlet valve and forcing water through the discharge piping. The lead column was taken out of service since the GAC was exchanged. The flow path was then rerouted to use the pilot system lag column as the development water treatment system lead column. A third column delivered to the site was used as the run lag column. Once the reconfiguration of the carbon columns had been completed, development water from the modular tank was pumped through the units until the full contents of the tank had been treated. Treated development water was routed to ABRTF.

The development water treatment system ran for approximately 12 hours. During operations, an ADVENT operator remained onsite to collect and ship samples for analysis. The samples taken were collected specifically for compliance monitoring as stipulated in the ABRTF permit. Samples collected were hand delivered to American Bottoms with the exception of cyanide, which was shipped to Severn Trent in Savannah. The operator conducted a walkthrough of the system every two hours to collect the

necessary samples. Flow to the pilot system was delivered at the maximum velocity for the available pump but was not monitored.

**TABLE 3-1. PILOT SYSTEM FLOW AND PRESSURE MEASUREMENTS**

DAY	TIME	RUN TIME (hr)	FLOW		PRESSURE		
			(gpm)	(total gal)	LEAD (psig)	LAG (psig)	DELTA (psig)
19-May	12:00	0	202.7	5,760			
	14:00	2	205.6	41,270			
	16:00	4	202.3	65,740			
	18:00	6	204.6	89,010			
	20:00	8	203.9	113,960	17	12	5
	22:00	10	202.6	139,636	18	12	6
20-May	0:00	12	201.5	164,228	17	12	5
	2:00	14	201.3	187,960	17	12	5
	4:00	16	200.2	213,350	17	12	5
	6:00	18	201.2	237,688	17	12	5
	8:00	20	200.2	260,510	17.5	12	5.5
	10:00	22	200.1	283,430	17.5	12	5.5
	12:00	24	199.4	308,970	18	12.5	5.5
	14:00	26	198.6	331,571	18	12.5	5.5
	16:00	28	198.2	355,425	17.9	12	5.9
	18:00	30	197.5	378,760	18	13	5
	20:00	32	196.7	403,796	18	14	4
	22:00	34	195.8	427,789	18	14	4
21-May	0:00	36	196.0	449,944	18	14	4
	2:00	38	194.5	474,128	18	14	4
	4:00	40	194.4	497,596	19	14	5
	6:00	42	193.2	522,339	19	14	5
	8:00	44	203.0	544,400	20	14.4	5.6
	10:00	46	201.6	565,850	20.1	14.5	5.6
	12:00	48	200.4	590,540	20	15	5
	14:00	50	200.0	614,420	20.5	15	5.5
	16:00	52	199.0	638,370	21.1	15	6.1
	18:00	54	197.8	663,290	21	15	6
	20:00	56	197.1	687,526	21	16	5
	22:00	58	196.3	712,320	22	16	6
22-May	0:00	60	196.0	734,778	21	16	5
	2:00	62	201.6	759,620	22	16	6
	4:00	64	200.3	783,692	22	16	6
	6:00	66	199.6	805,332	22	16	6
	8:00	68	197.6	830,454	22.5	15.5	7
	10:00	70	199.0		23	14.5	8.5
	12:00	72	198.0	877,530	23	15	8
	14:00	74	197.0	902,160	23	15	8
	16:00	76	196.1	925,970			
	18:00	78	201.3	948,570	24	15	9
	20:00	80	200.7	973,836	22	15	7
	22:00	82	199.4	998,599	24	16	8

**TABLE 3-1. PILOT SYSTEM FLOW AND PRESSURE MEASUREMENTS**

DAY	TIME	RUN TIME (hr)	FLOW		PRESSURE		
			(gpm)	(total gal)	LEAD (psig)	LAG (psig)	DELTA (psig)
23-May	0:00	84	198.6	1,021,080	24	15	9
	2:00	86	197.2	1,046,273	22	15	7
	4:00	88	195.6	1,069,100	24	15	9
	6:00	90	195.0	1,090,722	25	15	10
	8:00	92	194.4	1,115,180	25	14.5	10.5
	10:00	94	191.1	1,138,130	26	14.5	11.5
	12:00	96	190.1	1,160,825	26	14.5	11.5
	14:00	98	189.0	1,184,322	27	14.5	12.5
	16:00	100	188.3	1,206,930	27	14.5	12.5
	18:00	102	187.0	1,228,777	27	14	13
	20:00	104	185.9	1,252,342	27	14	13
	22:00	106	184.7	1,274,310	28	14	14
24-May	0:00	108	183.9	1,295,136	28	14	14
	2:00	110	183.3	1,317,700	28	14	14
	4:00	112	180.4	1,340,300	28	14	14
	6:00	114	180.6	1,360,556	28	14	14
	8:00	116	179.0	1,384,330	29	14	15

**TABLE 3-2. DESIGN AND RESULTS FOR RSSCT BREAKTHROUGH DETERMINATION TEST**

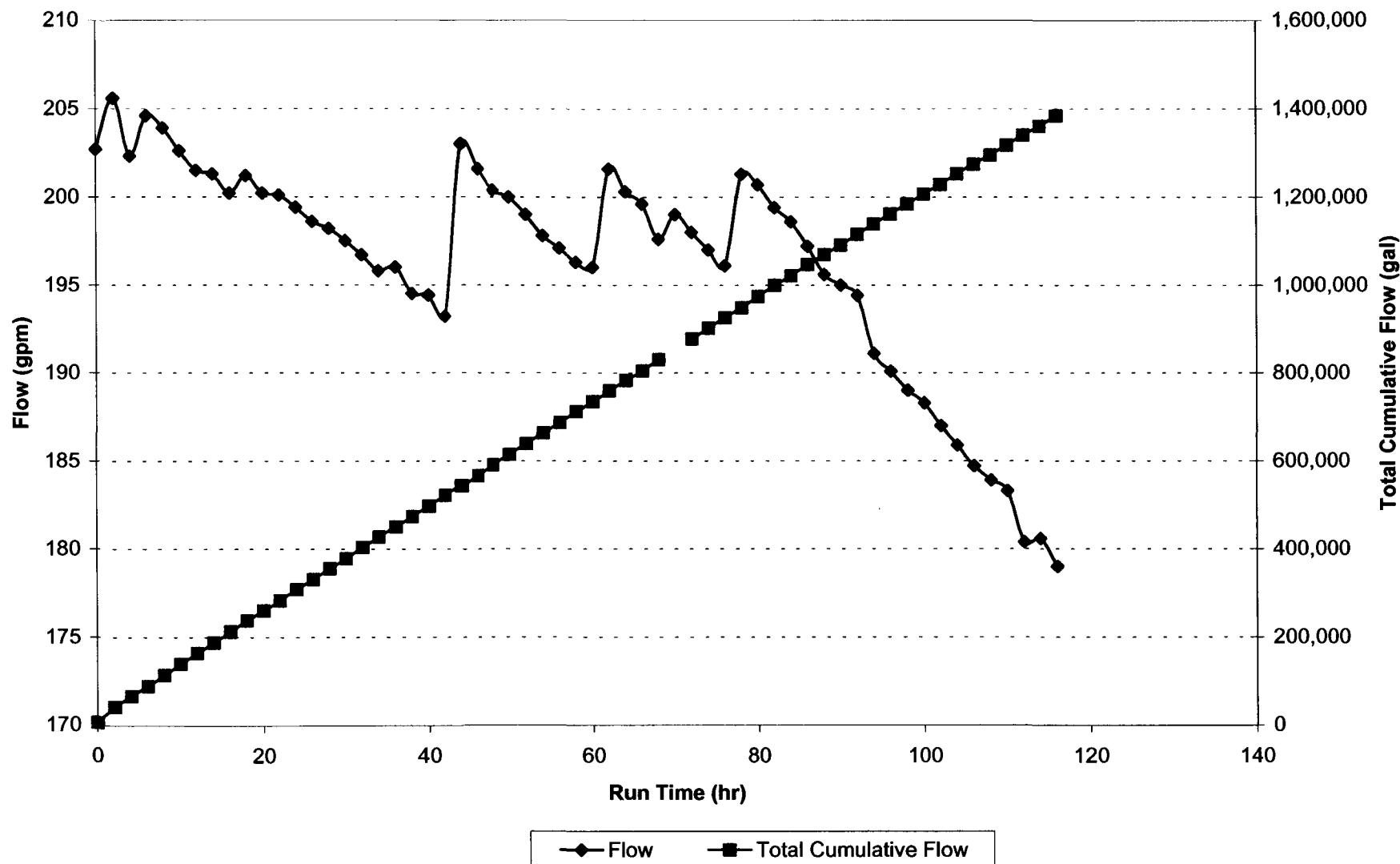
**RSSCT DESIGN - COD BREAKTHROUGH TEST**

PARAMETER	RSCCT	PILOT
Column Diameter, cm	1	243.8
Carbon Particle Radius, mm	0.106	0.792
Empty Bed Contact Time, min	0.30	16.9
Hydraulic Loading Rate, gpm/ft <sup>2</sup>	29.73	3.98
Required Time to Breakthrough*, days - with 20% safety factor	0.104 0.125	5.80
Run Time, hr	2.99	
Column Cross-section, ft <sup>2</sup>	0.00102	50.3
Flow, gpm	0.0304	200
Flow, mL/min	115.10	
Bed Volume, mL	34.88	
Bed Depth, cm	36.71	
Influent Required Per Test, gal	5.46	
Influent Required Per Test, L	20.66	

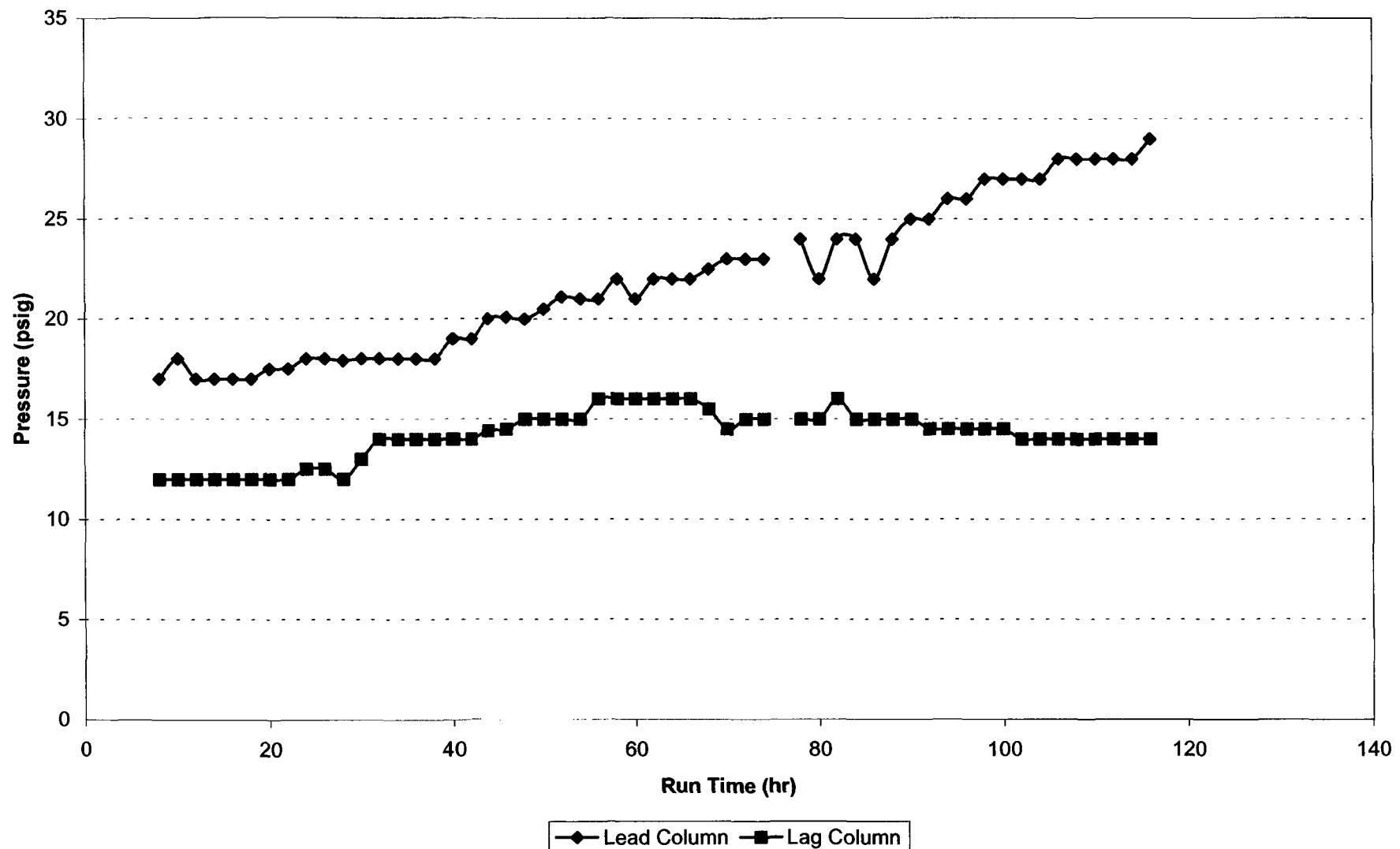
Actual Bed Depth, cm 37  
Influent COD (mg/L) 596

Time	Flow (mL/min)	COD (mg/L)
0:00	94	75
0:10	94	65
0:20	94	70
0:30	94	83
0:40	94	108
0:50	94	117
1:00	96	123
1:10	94	152
1:20	95	184
1:30	99	227
1:40	99	269
1:50	94	300
2:00	98	335
2:10	98	358
2:20	100	376
2:30	96	400
2:40	98	439
2:50	98	457
3:00	96	446

**FIGURE 3-1. PILOT SYSTEM FLOW**



**FIGURE 3-2. PILOT SYSTEM PRESSURE**





## **4.0 ANALYTICAL RESULTS**

### **4.1 PILOT SYSTEM**

As described in Section 2.4, three locations were sampled during the study.

1. Point A represented influent groundwater to the pilot system.
2. Point B represented the effluent from the lead column of the pilot system.
3. Point C represented the effluent from the lag column.

#### **4.1.1 Onsite Analyses**

Analytical results from testing conducted onsite by ADVENT operators are presented in Table 4-1. Initial pH measurements showed an increase as the groundwater passed through the carbon, though after 6 hours of operation the readings stabilized in the range of 6.4-6.7 s.u. This is consistent with the leaching of residual ash in the activated carbon during initial flow, which would cause a pH increase. Conductivity remained relatively constant throughout the study, typically ranging from 1,800-2,400  $\mu\text{S}\cdot\text{cm}$ . Temperature readings displayed a cyclical pattern consistent with the alternating periods of warm, sunny days and cool evenings. Typical temperature measurements ranged from 14 to 20 °C.

Initial samples of pilot system influent indicated a COD of approximately 600 mg/L, considerably lower than the anticipated value of 900 mg/L. After approximately 14 hours of operation, the influent COD stabilized in the range of 480-500 mg/L for the five-day duration of the study. COD measurements for the lead column effluent (Point B) gradually increased throughout the operation of the pilot system, with the highest recorded value at 219 mg/L. The breakthrough curve observed for the lead column, defined as the percentage of influent COD observed in the effluent, is shown in Figure 4-1.

Operators began regularly monitoring the COD of the lag column effluent (Point C) after approximately three days of operation. This monitoring was conducted to monitor for permit compliance. Earlier COD measurements at Point B indicated a refractory COD of 40-50 mg/L during the period when few or no compounds had broken through the lead column. Based on these data, it was determined that COD concentration of 55 to 60 mg/L at Point C would signal the onset of breakthrough in the lag column, and thus would present a higher potential for a permit violation of associated specific organics. Such measurements were observed Saturday, May 24, at which time the flow to the pilot system was ceased.

#### 4.1.2 Offsite Analyses

Analytical results for all samples analyzed through Severn Trent Laboratories are presented in Table 4-2. These samples were collected and analyzed independent of the permit requirements to provide more complete groundwater characterization and evaluate treatment effectiveness. Cyanide was the only parameter monitored for compliance purposes. Because the permit-required sampling schedule for cyanide differed from the other samples sent to Severn Trent, the cyanide results are shown separately in Table 4-2a. Most parameters analyzed were not detected in the influent, or sporadically detected at concentrations near the listed detection limits.

#### 4.1.3 Influent Characterization

Table 4-3 presents results of all constituents analyzed in the extracted groundwater prior to GAC treatment. Parameters identified at an influent concentration of 1 mg/L or higher are summarized below:

Parameter	Units	Influent Concentration Range
<b>Metals</b>		
Calcium	mg/L	260 – 280
Iron	mg/L	17 – 20
Magnesium	mg/L	61 – 65
Manganese	mg/L	2.6 – 2.9
Potassium	mg/L	14 – 15
Sodium	mg/L	120 – 150
Total Organic Carbon	mg/L	130 – 180
Chemical Oxygen Demand	mg/L	446 – 600
Biochemical Oxygen Demand	mg/L	126 – 143

Parameter	Units	Influent Concentration Range
Total Suspended Solids	mg/L	4 – 36
Ammonia	mg/L	10.3 – 14.9
Total Kjeldahl Nitrogen	mg/L	14.8 – 27.6
<b>Volatiles</b>		
Chlorobenzene	mg/L	2.3 – 3.9
Toluene	mg/L	0.7 – 1.2
Acetone	mg/L	3.0 – 6.7
<b>Semi-Volatiles</b>		
2-Chloroaniline	mg/L	22 – 31
4-Chloroaniline	mg/L	12 – 21
Aniline	mg/L	17 – 35
Phenol	mg/L	3.4 – 6.5
2-Nitrochlorobenzene	mg/L	3.7 – 25
3-Chloroaniline	mg/L	14 – 37
4-Chlorophenol	mg/L	2.8 – 7.1
4-Nitrochlorobenzene	mg/L	1.1 – 7.5

As predicted by the color change in the samples (Section 3.1), the groundwater contained an appreciable quantity of iron, in addition to other metals typically present in moderately hard water. The major contributors to the total organic carbon (TOC) in the groundwater include a variety of semivolatile organics, typically chlorinated and/or aminated aromatics.

#### 4.1.4 Treated Effluent Quality

Only a few of the compounds listed in the above table were detected in the effluent at levels suggesting they had begun to break through the GAC bed. The following matrix shows which compounds were detected at the three sampling locations. (Refer to Sections 4.1.3 and 5.1 for complete influent and effluent summaries).

PARAMETER	POINT A	POINT B	POINT C
<b>Metals</b>			
Barium	X	X	X
Iron	X	X	X
Potassium	X	X	
Magnesium	X	X	
Manganese	X	X	X
Sodium	X	X	
Zinc	X	X	X
<b>Volatiles</b>			
Benzene	X	X	
Chlorobenzene	X	X	X*
Chloroethane	X	X	
Toluene	X	X	X*
Vinyl chloride	X	X	
Acetone	X	X	X

PARAMETER	POINT A	POINT B	POINT C
<b>Semi-Volatiles</b>			
2-Chlorophenol	X	X	
2-Chloroaniline	X	X	X*
Aniline	X	X	X
Phenol	X	X	X
3-Chloroaniline	X	X	
4-Chlorophenol	X	X	
<b>Herbicides</b>			
2,4-D	X	X	

Notes:

\* Constituents detected at Point C by ABRTF but below the MDLs used by Severn Trent Laboratories.

Among the organic compounds, only acetone was detected at a concentration near or above the influent level. Figure 4-2 shows the progressive breakthrough of various compounds detected at high effluent concentrations, in addition to the breakthrough curve for TOC. As shown, the effluent concentration of acetone is higher than the influent concentration for samples collected after approximately 50 hours of run time. It is believed that this apparent increase in concentration may be due to the displacement of adsorbed acetone in the upper portion of the carbon bed by larger, more readily adsorbed compounds. As a result, the saturation capacity of acetone in the carbon decreases, and the desorbed acetone is discharged in the lead column effluent in addition to the influent acetone that is unable to be adsorbed in the bed.

#### 4.1.5 Analytical Validation

In order to provide a cross-check between laboratories, splits of the ABRTF composite samples for Points A and C were shipped to STL Savannah for analysis. These split composite samples were analyzed for semi-volatile compounds only, as this analysis would provide the largest number of individual parameters for comparison. The complete results for these composite samples, from ABRTF and STL, are provided in Table 4-4. There was no apparent difference between the two laboratories in the analytical results obtained from samples collected at Point C. For most data points collected for Point A, where both laboratories provided a result above their respective detection limits, the results fall within the same order of magnitude. The following summarizes the data points in which the relative percent difference between the reported results exceeded 50 percent.

PARAMETER	UNITS	5/19/03			5/20/03			5/21/03		
		STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff
1,2-Dichlorobenzene	µg/l	450	378	17.4%	480	443	8.0%	430	212	67.9%
1,4-Dichlorobenzene	µg/l	420	414	1.4%	390	345	12.2%	360	91	119.3%
2-Chloroaniline	µg/l	32,000	35,500	10.4%	26,000	29,600	12.9%	24,000	14,100	52.0%
2-Nitrochlorobenzene	µg/l	4,200	944	126.6%	12,000	9,940	18.8%	18,000	4,800	115.8%
3-Chloroaniline	µg/l	20,000	11,100	57.2%	21,000	9,830	72.5%	20,000	3,970	133.8%
4-Chloroaniline	µg/l	19,000	23,300	20.3%	16,000	17,900	11.2%	13,000	6,280	69.7%
4-Nitrochlorobenzene	µg/l	2,000	2,990	39.7%	3,800	2,900	26.9%	5,200	1,620	105.0%

#### 4.2 BENCH SCALE TREATABILITY UNITS

Analytical results from all of the bench-scale studies conducted at the site, including both onsite and offsite analyses, are presented in Table 4-4.

The influent and effluent results for the RSSCT indicate that its performance was comparable to the pilot system. Acetone was the only organic contaminant detected in the RSSCT effluent, indicating that its initial adsorptive capacity was comparable to that observed for the pilot system. In contrast to the pilot system, however, the RSSCT removed iron from the groundwater due to its oxidation and precipitation in the bed.

Results from the ozonation of pilot system influent (Point A) indicate that certain organic constituents in the groundwater may be fully removed by ozone, while others can be treated at lower degrees of effectiveness. A summary of the various ozone removal efficiencies is shown below:

Compound	Ozone Removal Efficiency (%)
Acetone	0%
Phenol	13%
4-Nitrochlorobenzene	37%
2-Chloroaniline	68%
Aniline	75%
4-Chloroaniline	79%
Chlorobenzene	> 99%
COD (total)	15%
TOC (total)	15%

Ozonation of water from Point C (GAC pilot effluent) did not provide useful data, since acetone was the only organic component detected in the influent to the ozonation system, and it was not removed by ozone.

#### **4.3 DEVELOPMENT WATER TREATMENT**

In order to comply with the sampling requirements of the ABRTF permit, grab samples for cyanide analysis were taken at Point A and Point C during development water treatment. The results for these samples are listed in Table 4-2a under the sample identification "5/29 12 PM," which constituted the seventh day of operation. All other samples for permit compliance were collected and analyzed by ABRTF personnel.

TABLE 4-1. PILOT SYSTEM ONSITE ANALYTICAL RESULTS

DAY	TIME	RUN TIME (hr)	COD (mg/L)			pH (s.u.)			TEMPERATURE (°C)			CONDUCTIVITY (uS-cm)			TSS (mg/L)	
			Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B
19-May	12:00	0				6.46	7.19	8.73	17.5	17.5	19.9	2,520	2,530	1,930	9	3
	14:00	2	600	62	62 <sup>(a)</sup>	6.44	6.68	7.15	20.3	23.2	21.2	2,500	2,460	2,440		
	16:00	4	589	46	40 <sup>(a)</sup>	6.59	6.6	6.77	19.4	22.5	19.7	2,490	2,590	2,490		
	18:00	6	544	45		6.58	6.59	6.69	17.3	17.7	18	1,920	2,200	2,280	18	3
	20:00	8	538	42		6.53	6.51	6.52	17.5	17.9	18.1	2,230	1,970	2,350		
	22:00	10	527	40		6.49	6.48	6.51	16.7	18.4	18	2,190	2,230	2,200		
20-May	0:00	12	550	44		6.51	6.54	6.52	16.9	16.4	16.7	2,240	2,340	2,380	3.6	0.8
	2:00	14	517	38		6.47	6.54	6.49	17.7	17.3	17.5	2,250	2,270	2,210		
	4:00	16	525	33		6.56	6.64	6.58	16.4	16.4	16.4	2,290	2,300	2,300		
	6:00	18	518	41		6.43	6.37	6.47	15.7	15.4	15.6	1,830	1,850	1,810	20.8	16.5
	8:00	20	510	42		6.59	6.6	6.5	15.1	14.8	14.9	2,340	2,290	2,250		
	10:00	22	499	44		6.63	6.68	6.61	16.3	16.2	16.2	2,430	2,430	2,430		
	12:00	24	497	65	65 <sup>(a)</sup>	6.61	6.59	6.59	17.2	17.1	17.1	2,380	2,390	2,300	20.4	4.6
	14:00	26	500	81		6.48	6.51	6.49	19.1	22.8	17.3	2,260	2,300	2,320		
	16:00	28	500	62		6.59	6.59	6.54	17.9	18.1	18.1	2,270	2,270	2,300		
	18:00	30	495	72		6.53	6.55	6.57	16.6	18.6	16.9	1,860	1,850	1,890	18.2	4.4
	20:00	32	479	65		6.5	6.51	6.54	16.6	17.3	16.9	1,820	1,860	1,850		
	22:00	34	482	69		6.11	6.44	6.51	16	16.2	16.3	2,280	2,300	2,190		
21-May	0:00	36	485	74		6.31	6.46	6.5	15.7	15.8	15.7	1,750	1,850	1,810	4.6	3.2
	2:00	38	501	83		6.55	6.51	6.56	15.3	15.3	14.8	1,780	1,810	1,840		
	4:00	40	488	68		6.58	6.52	6.53	14.8	14.4	14	2,220	2,210	2,230		
	6:00	42	485	72		6.53	6.54	6.61	14.8	14.1	15	2,090	2,190	1,830	4.4	3.2
	8:00	44	471	64		6.5	6.61	6.91	15.9	15.9	16.1	2,060	2,020	2,030		
	10:00	46	488	66		6.63	6.67	6.58	17.7	18.1	19.1	2,360	2,390	2,330		
	12:00	48	495	67		6.63	6.66	6.57	16.3	17.6	17	2,300	2,350	2,110	26.2	4.4
	14:00	50	458	81		6.54	6.57	6.57	17.8	19	17.3	2,040	2,220	2,150		
	16:00	52	469	84					17.1	17.1	17.1					
	18:00	54	517	96		6.55	6.6	6.6	16.1	16.3	16.4	1,920	1,880	1,870	12.4	8.8
	20:00	56	513	85		6.61	6.7	6.69	16.4	17.3	16.8	1,880	1,940	2,030		
	22:00	58	475	96		6.5	6.56	6.59	15.8	15.7	15.4	2,170	2,300	2,222		

TABLE 4-1. PILOT SYSTEM ONSITE ANALYTICAL RESULTS

DAY	TIME	RUN TIME (hr)	COD (mg/L)			pH (s.u.)			TEMPERATURE (°C)			CONDUCTIVITY (uS-cm)			TSS (mg/L)	
			Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B
22-May	0:00	60	539	89		6.51	6.59	6.61	15.1	14.9	15.3	2,140	2,220	2,190	2.6	8.8
	2:00	62	482	89		6.53	6.58	6.54	14.6	13.6	14.2	2,140	2,180	2,120		
	4:00	64	446	98		6.49	6.61	6.5	14.8	14.5	14.4	2,190	2,200	2,240		
	6:00	66	480	114		6.57	6.55	6.63	14.2	14.3	14.2	2,100	2,220	2,240	1.2	0.6
	8:00	68	476	104		6.51	6.61	6.59	15.9	15.6	16.2	2,310	2,220	2,280		
	10:00	70	487	113	40	6.56	6.57	6.57	17.1	16.6	17	2,390	2,300	2,030		
	12:00	72	508	107	43	6.66	6.67	6.7	17.1	17.2	17.1	2,330	2,390	2,330	36.2	11.4
	14:00	74	470	118	44	6.66	6.62	6.6	17	18.8	18.9	2,140	2,410	2,180		
	16:00	76	487	119	44	6.6	6.58	6.6	18.8	18.4	17.1	2,410	2,340	2,150		
	18:00	78	479	121	40	6.58	6.56	6.64	16.9	20.5	17.3	2,290	2,340	2,320	12.4	2.6
	20:00	80	519	125	41	6.56	6.64	6.63	17.2	19.7	16.7	2,160	2,390	2,170		
	22:00	82	567	123	37	6.55	6.55	6.6	15.5	16.3	15.8	2,300	2,340	2,300		
23-May	0:00	84	514	125	47	6.62	6.62	6.64	14.2	14.6	14.5	2,210	2,070	2,160	5.6	5.8
	2:00	86	478	97	46	6.6	6.61	6.61	13.4	13.9	14.1	2,020	2,220	2,210		
	4:00	88	506	142	47	6.63	6.67	6.65	14.5	14.5	13.8	2,230	2,220	2,250		
	6:00	90	486	131	35	6.58	6.6	6.6	14.4	13.7	13.8	2,120	2,060	2,150		
	8:00	92	483	138	33	6.55	6.5	6.62	15.9	15.7	16.3	2,370	2,250	2,350		
	10:00	94	482	143	41	6.61	6.59	6.72	18.7	17.7	16.8	2,460	2,380	2,370		
	12:00	96	501	145	37	6.62	6.61	6.63	16.6	17	17.3	2,410	2,420	2,400		
	14:00	98	478	152	44	6.61	6.63	6.59	18.1	25.2	18.6	2,390	2,660	2,420		
	16:00	100	480	146	38	6.54	6.61	6.66	17.2	16.6	17.2	2,130	2,330	2,390		
	18:00	102	474	168	48	6.61	6.57	6.59	16.6	16.8	16.8	2,330	2,140	2,200		
	20:00	104	472	162	52	6.6	6.64	6.63	16.7	18	16.7	2,100	2,170	2,200		
	22:00	106	450	174	48	6.56	6.63	6.6	16.1	16.1	16.1	2,280	2,280	2,200		
24-May	0:00	108	455	182	57	6.55	6.61	6.62	14.9	14.7	14.5	2,090	2,170	2,190		
	2:00	110	475	186	55	6.56	6.62	6.63	14.6	14.7	15	2,140	2,130	2,100		
	4:00	112	469	190	58	6.57	6.6	6.61	14.6	14.2	14.4	2,090	2,080	2,040		
	6:00	114	465	218	69	6.61	6.58	6.58	14.6	14.1	14.9	2,180	2,120	2,160		
	8:00	116	485	191	55	6.63	6.62	6.63	16.3	16.6	16.5	2,380	2,390	2,340		

Notes:

- (a) Initial COD analyses at Point C were run using the high range Hach method. Subsequent samples were analyzed using the low range HACH method and are assumed to be more indicative of the actual COD concentrations at Point C.

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT A																POINT B									
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03		5/24/03									
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM		
<b>Miscellaneous</b>																											
Total Organic Carbon	mg/l	180	150	150	150	150	140	140	140	140	140	140	140	140	130	130	130	130	140	140	140	140	140	140	130	130	
<b>Volatiles</b>																											
1,1-Dichloroethene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
1,2-Dichloroethene (total)	ug/l	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
2-Butanone (MEK)	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	
2-Hexanone	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	
Benzene	ug/l	440	410	430	440	450	430	470	460	500	470	480	450	460	460	450	440	450	460	450	440	450	460	450	480	300	
4-Methyl-2-pentanone (MIBK)	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	
Bromoform	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
Carbon tetrachloride	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
Chlorobenzene	ug/l	3300	3300	3000	3200	3000	3200	3200	3900	3200	3300	3100	3100	3000	3100	3000	3600	3600	3300	3600	3600	3300	3600	3600	3300	3300	
cis-1,3-Dichloropropene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
trans-1,3-Dichloropropene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
Chloroethane	ug/l	<20	<20	28	27	29	30	30	35	58	30	32	26	28	26	28	24	40	63	25							
2-Chloroethylvinyl ether	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	
Chloroform	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
1,1-Dichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
1,2-Dichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
1,2-Dichloropropane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
Ethylbenzene	ug/l	85	83	81	90	92	89	91	93	100	93	98	91	92	89	90	92	97	100	66							
Methylene chloride (Dichloromethane)	ug/l	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
1,1,2,2-Tetrachloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
Toluene	ug/l	1000	960	920	980	1000	950	1000	990	1200	1000	940	930	980	950	970	940	1000	1100	720							
trans-1,2-Dichloroethene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
1,1,1-Trichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	
1,1,2-Trichloroethane	ug/l	<20	<20	<20	<																						

**TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS**

**TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS**

**TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS**

## **Qualifiers**

**E = Estimated value**

P = Presence of parameter confirmed but accuracy of result suspect

ND = Not Detected

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B												POINT B												POINT C		
		5/19/03			5/20/03			5/21/03			5/22/03			5/23/03			5/24/03			5/24/03			5/24/03					
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	10 AM		
<b>Miscellaneous</b>																												
Total Organic Carbon	mg/l	14	16	16	17	18	19	21	23	26	28	31	34	39	42	46	49	54	57	59	63							
<b>Volatiles</b>																												
1,1-Dichloroethene	ug/l	<1	<1	<2	<10	<10	<10	<10	<10	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
1,2-Dichloroethene (total)	ug/l	<5	<5	<10	<50	<50	<50	<5	<100	<100	<100	<100	<100	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<120			
2-Butanone (MEK)	ug/l	<10	<10	<20	<100	<100	<100	14	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<250			
2-Hexanone	ug/l	<10	<10	<20	<100	<100	<100	<10	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<250			
Benzene	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	26	36	40	53	71	49	93	<25							
4-Methyl-2-pentanone (MIBK)	ug/l	<10	<10	<20	<100	<100	<100	<10	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<250			
Bromoform	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Carbon tetrachloride	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Chlorobenzene	ug/l	2.8	<1	2.8	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
cis-1,3-Dichloropropene	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
trans-1,3-Dichloropropene	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Chloroethane	ug/l	<1	<1	<2	<10	<10	<10	7.8	<20	<20	<20	<20	<20	22	24	21	29	26	33	62	<25							
2-Chloroethylvinyl ether	ug/l	<10	<10	<20	<100	<100	<100	<10	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<250				
Chloroform	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
1,1-Dichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
1,2-Dichloroethane	ug/l	<1	<1	<2	<10	<10	<10	1.2	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<15	<25			
1,2-Dichloropropane	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Ethylbenzene	ug/l	1.4	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Methylene chloride (Dichloromethane)	ug/l	<5	<5	<10	<50	<50	<50	<5	<100	<100	<100	<100	<100	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<120			
1,1,2-Tetrachloroethane	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Toluene	ug/l	<1	<1	2.7	<10	<10	<10	1.3	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
trans-1,2-Dichloroethene	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
1,1,1-Trichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
1,1,2-Trichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25			
Vinyl chloride	ug/l	<1</td																										

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B												POINT B												POINT C		
		5/19/03			5/20/03			5/21/03			5/22/03			5/23/03			5/24/03			5/24/03			5/24/03					
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	10 AM				
Benzo(g,h,i)perylene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<200	<100	<250	<250	<250	<10	<10	<10				
Pentachlorophenol	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<500	<500	<1000	<500	<1200	<1200	<50	<50	<50	<50				
Phenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	24	<10	93	210E	300	610	690	1100	1400	1900	1400	1900	1900	1600	13				
bis(2-Chloroethoxy)methane	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10				
2,4,6-Trichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
bis(2-Chloroethyl)ether	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10				
bis(2-Ethylhexyl)phthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10				
4-Bromophenylphenyl ether	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10				
Butylbenzylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
2-Chloronaphthalene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
4-Chlorophenylphenyl ether	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10				
Chrysene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Dibenzo(a,h)anthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
1,2-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
1,3-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
1,4-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
3,3'-Dichlorobenzidine	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<100	<200	<200	<400	<200	<500	<500	<20	<20	<20	<20			
Dimethylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Di-n-butylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
2,4-Dinitrotoluene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
2,6-Dinitrotoluene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Di-n-octylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
1,2-Diphenylhydrazine	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Fluoranthene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Fluorene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Hexachlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10	<10	<10			
Hexachlorobutadiene	ug/l	<10	<10	<10	&lt																							

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B												POINT B												POINT C	
		5/19/03			5/20/03			5/21/03			5/22/03			5/23/03			5/24/03			5/24/03		5/24/03					
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	10 AM					
Endrin	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Endrin aldehyde	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Heptachlor	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Heptachlor epoxide	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Toxaphene	ug/l	<2.5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5			
alpha-Chlordane	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Endrin ketone	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
gamma-Chlordane	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				
Methoxychlor	ug/l	<0.25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
<b>Herbicides</b>																											
2,4,5-TP (Silvex)	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
2,4-DB	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
2,4-D	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.82	1.3	1.7	2.6	3.3	3.5	4.1	4.3						
2,4,5-T	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
Pentachlorophenol	ug/l	<2	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1			
Dalapon	ug/l	<240	<120	<120	<120	<120	<1200	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120			
Dicamba	ug/l	<2.4	<1.2	<1	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2			
Dichloroprop	ug/l	<12	<6.0	<6	<6.0	<6	<6.0	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6			
MCPP[(4-chloro-2-methylphenoxy)-acetic acid]	ug/l	<240	<120.0	<120	<120.0	<120	<1200	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120			
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/l	<240	<120.0	<120	<120.0	<120	<1200	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120			
<b>PCBs</b>																											
Decachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				
Dichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Heptachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3				
Hexachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
Monochlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Nonachlorobiphenyl	ug/l	<0.5	<0.5	<0.5																							

**TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS**

**Qualifiers:**

E = Estimated value

P = Presence of parameter confirmed but accuracy of result suspect

ND = Not Detected

TABLE 4-2a. PILOT SYSTEM CYANIDE RESULTS

SAMPLE DATE	RUN DAY	UNITS	POINT A	POINT C
5/19/03 12 PM	1	mg/L	<0.01	<0.01
5/21/03 12 PM	3	mg/L	<0.01	<0.01
5/22/03 12 PM	4	mg/L	<0.01	<0.01
5/23/03 12 PM	5	mg/L	<0.01	<0.01
5/29/03 12 PM	7	mg/L	<0.01	<0.01

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
<b>Miscellaneous</b>				
Total Organic Carbon	mg/L	142	130	180
Ammonia	mg/L	13	10	15
TKN	mg/L	19	16	23
TSS	mg/L	13	3	36
BOD	mg/L	138	126	162
COD	mg/L	497	446	600
<b>Volatiles</b>				
1,1-Dichloroethene	ug/L	<20	<20	<20
1,2-Dichloroethene (total)	ug/L	<100	<100	<100
2-Butanone (MEK)	ug/L	<200	<200	<200
2-Hexanone	ug/L	<200	<200	<200
Benzene	ug/L	447	300	500
4-Methyl-2-pentanone (MIBK)	ug/L	<200	<200	<200
Bromoform	ug/L	<20	<20	<20
Carbon tetrachloride	ug/L	<20	<20	<20
Chlorobenzene	ug/L	3,185	2,300	3,900
cis-1,3-Dichloropropene	ug/L	<20	<20	<20
trans-1,3-Dichloropropene	ug/L	<20	<20	<20
Chloroethane	ug/L	31	20	63
2-Chloroethylvinyl ether	ug/L	<200	<200	<200
Chloroform	ug/L	<20	<20	<20
1,1-Dichloroethane	ug/L	<20	<20	<20
1,2-Dichloroethane	ug/L	<20	<20	<20
1,2-Dichloropropane	ug/L	36	20	330
Ethylbenzene	ug/L	90	66	100
Methylene chloride (Dichloromethane)	ug/L	<100	<100	<100
1,1,2,2-Tetrachloroethane	ug/L	<20	<20	<20
Toluene	ug/L	977	720	1,200
trans-1,2-Dichloroethene	ug/L	20	20	20
1,1,1-Trichloroethane	ug/L	20	20	20
1,1,2-Trichloroethane	ug/L	20	20	20
Vinyl chloride	ug/L	28	20	36
Acetone	ug/L	4,285	3,000	6,700
Bromodichloromethane	ug/L	20	20	20
Bromomethane (Methyl bromide)	ug/L	20	20	20
Chloromethane	ug/L	20	20	20
Carbon disulfide	ug/L	20	20	20
Dibromochloromethane	ug/L	20	20	20
Styrene	ug/L	20	20	20
Tetrachloroethene	ug/L	22	20	32
Trichloroethene	ug/L	32	22	39
Xylenes, Total	ug/L	505	370	620

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
<b>Semi-Volatiles</b>				
2-Chlorophenol	ug/L	303	10	500
Acenaphthene	ug/L	113	10	250
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/L	113	10	250
2-Nitroaniline	ug/L	563	50	1,200
2-Chloroaniline	ug/L	23,863	16	32,000
2-Methylnaphthalene	ug/L	113	10	250
2-Methylphenol (o-Cresol)	ug/L	113	10	250
2,4-Dichlorophenol	ug/L	241	10	300
Acenaphthylene	ug/L	113	10	250
3-Nitroaniline	ug/L	563	50	1,200
2,4-Dimethylphenol	ug/L	113	10	250
Anthracene	ug/L	113	10	250
4,6-Dinitro-2-methylphenol	ug/L	563	50	1,200
4-Chloroaniline	ug/L	14,326	20	21,000
4-Chloro-3-methylphenol	ug/L	113	10	250
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/L	348	10	540
4-Nitroaniline	ug/L	563	50	1,200
2,4-Dinitrophenol	ug/L	563	50	1,200
2-Nitrophenol	ug/L	113	10	250
Benzo(a)pyrene	ug/L	113	10	250
4-Nitrophenol	ug/L	563	50	1,200
Aniline	ug/L	24,474	3,000	35,000
Benzo(a)anthracene	ug/L	113	10	250
Benzo(b)fluoranthene	ug/L	113	10	250
Diethylphthalate	ug/L	113	10	250
Pyridine	ug/L	563	50	1,200
2,4,5-Trichlorophenol	ug/L	113	10	250
Benzo(g,h,i)perylene	ug/L	113	10	250
Pentachlorophenol	ug/L	563	50	1,200
<b>Phenol</b>	<b>ug/L</b>	<b>4,103</b>	<b>10</b>	<b>6,500</b>
bis(2-Chloroethoxy)methane	ug/L	113	10	250
2,4,6-Trichlorophenol	ug/L	117	10	250
bis(2-Chloroethyl)ether	ug/L	188	10	1,600
bis(2-Ethylhexyl)phthalate	ug/L	113	10	250
4-Bromophenylphenyl ether	ug/L	113	10	250
Butylbenzylphthalate	ug/L	113	10	250
2-Chloronaphthalene	ug/L	113	10	250
4-Chlorophenylphenyl ether	ug/L	113	10	250
Chrysene	ug/L	113	10	250
Dibenzo(a,h)anthracene	ug/L	113	10	250
1,2-Dichlorobenzene	ug/L	468	10	620
1,3-Dichlorobenzene	ug/L	113	10	250
<b>1,4-Dichlorobenzene</b>	<b>ug/L</b>	<b>392</b>	<b>10</b>	<b>510</b>
3,3'-Dichlorobenzidine	ug/L	226	20	500
Dimethylphthalate	ug/L	113	10	250
Di-n-butylphthalate	ug/L	113	10	250
2,4-Dinitrotoluene	ug/L	113	10	250
2,6-Dinitrotoluene	ug/L	113	10	250

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Di-n-octylphthalate	ug/L	113	10	250
1,2-Diphenylhydrazine	ug/L	113	10	250
Fluoranthene	ug/L	113	10	250
Fluorene	ug/L	113	10	250
Hexachlorobenzene	ug/L	113	10	250
Hexachlorobutadiene	ug/L	113	10	250
Hexachlorocyclopentadiene	ug/L	113	10	250
Hexachloroethane	ug/L	113	10	250
1Aeno(1,2,3-cd)pyrene	ug/L	113	10	250
Isophorone	ug/L	113	10	250
<b>Naphthalene</b>	ug/L	<b>632</b>	10	<b>1,500</b>
Nitrobenzene	ug/L	113	10	250
N-Nitrosodimethylamine	ug/L	113	10	250
N-Nitrosodiphenylamine	ug/L	113	10	250
Phenanthrene	ug/L	113	10	250
Pyrene	ug/L	113	10	250
1,2,4-Trichlorobenzene	ug/L	113	10	250
Benzo(k)fluoranthene	ug/L	113	10	250
<b>Benzoic acid</b>	ug/L	<b>747</b>	<b>50</b>	<b>1,200</b>
Benzyl alcohol	ug/L	113	10	250
Carbazole	ug/L	113	10	250
Dibenzofuran	ug/L	113	10	250
Dinoseb	ug/L	113	10	250
N-Nitroso-di-n-propylamine	ug/L	113	10	250
<b>2-Nitrochlorobenzene</b>	ug/L	<b>16,036</b>	10	<b>25,000</b>
<b>3-Chloroaniline</b>	ug/L	<b>18,751</b>	10	<b>37,000</b>
<b>3-Nitrochlorobenzene</b>	ug/L	<b>1,881</b>	10	<b>5,000</b>
<b>4-Chloro-2,6-Dinitrophenol</b>	ug/L	<b>37,020</b>	<b>200</b>	<b>100,000</b>
<b>4-Chlorophenol</b>	ug/L	<b>3,631</b>	10	<b>7,100</b>
<b>4-Nitrochlorobenzene</b>	ug/L	<b>4,666</b>	10	<b>7,600</b>
<b>Benzidine</b>	ug/L	<b>14,808</b>	<b>80</b>	<b>40,000</b>
<b>Pesticides</b>				
Aldrin	ug/L	<0.05	<0.03	<0.05
alpha-BHC	ug/L	<0.05	<0.03	<0.05
beta-BHC	ug/L	<0.05	<0.03	<0.05
gamma-BHC (LiNAane)	ug/L	<0.05	<0.03	<0.05
delta-BHC	ug/L	<0.05	<0.03	<0.05
Chlordane (technical)	ug/L	<0.5	<0.3	<0.5
4,4'-DDT	ug/L	<0.1	<0.1	<0.1
ENAosulfan I	ug/L	<0.05	<0.03	<0.05
ENAosulfan II	ug/L	<0.1	<0.1	<0.1
4,4'-DDE	ug/L	<0.1	<0.1	<0.1
4,4'-DDD	ug/L	<0.1	<0.1	<0.1
Dieldrin	ug/L	<0.1	<0.1	<0.1
ENAosulfan sulfate	ug/L	<0.1	<0.1	<0.1
ENArin	ug/L	<0.1	<0.1	<0.1
ENArin aldehyde	ug/L	<0.1	<0.1	<0.1
Heptachlor	ug/L	<0.05	<0.03	<0.05
Heptachlor epoxide	ug/L	<0.05	<0.03	<0.05

**TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Toxaphene	ug/L	<5	<3	<5
alpha-Chlordane	ug/L	<0.05	<0.03	<0.05
ENArin ketone	ug/L	<0.1	<0.1	<0.1
gamma-Chlordane	ug/L	<0.05	<0.03	<0.05
Methoxychlor	ug/L	<0.5	<0.3	<0.5
<b>Herbicides</b>				
2,4,5-TP (Silvex)	ug/L	0.5	0.5	1
2,4-DB	ug/L	0.5	0.5	1
<b>2,4-D</b>	ug/L	67	55	84
<b>2,4,5-T</b>	ug/L	4.6	4.4	4.7
<b>Pentachlorophenol</b>	ug/L	2.8	2.1	3.3
Dalapon	ug/L	<126	<120	<240
Dicamba	ug/L	<1.3	<1.2	<2.4
Dichloroprop	ug/L	ND	ND	ND
MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/L	<126	<120	<240
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/L	<126	<120	<240
<b>PCBs</b>				
Decachlorobiphenyl	ug/L	<0.5	<0.5	<0.5
Dichlorobiphenyl	ug/L	0.13	0.1	0.62
Heptachlorobiphenyl	ug/L	<0.3	<0.3	<0.3
Hexachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Monochlorobiphenyl	ug/L	0.14	0.1	0.32
Nonachlorobiphenyl	ug/L	<0.5	<0.5	<0.5
Octachlorobiphenyl	ug/L	<0.3	<0.3	<0.3
Pentachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Tetrachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Trichlorobiphenyl	ug/L	0.13	0.1	0.75
Aroclor-1242	ug/L	<1	<1	<1
Aroclor-1254	ug/L	<1	<1	<1
Aroclor-1221	ug/L	<2	<1	<2
Aroclor-1232	ug/L	<1	<1	<1
Aroclor-1248	ug/L	<1	<1	<1
Aroclor-1260	ug/L	<1	<1	<1
Aroclor-1016	ug/L	<1	<1	<1
<b>Dioxins</b>				
2,3,7,8-TCDD	ug/L	NA	NA	NA
<b>Total TCDD</b>	ug/L	1,428	300	3,700
1,2,3,7,8-PeCDD	ug/L	NA	NA	NA
<b>Total PeCDD</b>	ug/L	962	28	2,000
1,2,3,4,7,8-HxCDD	ug/L	NA	NA	NA
1,2,3,6,7,8-HxCDD	ug/L	NA	NA	NA
1,2,3,7,8,9-HxCDD	ug/L	NA	NA	NA
<b>Total HxCDD</b>	ug/L	1,567	1,200	1,800
1,2,3,4,6,7,8-HpCDD	ug/L	NA	NA	NA
Total HpCDD	ug/L	NA	NA	NA
OCDD	ug/L	NA	NA	NA
2,3,7,8-TCDF	ug/L	NA	NA	NA
<b>Total TCDF</b>	ug/L	NA	NA	NA
1,2,3,7,8-PeCDF	ug/L	NA	NA	NA

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
2,3,4,7,8-PeCDF	ug/L	NA	NA	NA
Total PeCDF	ug/L	NA	NA	NA
1,2,3,4,7,8-HxCDF	ug/L	NA	NA	NA
1,2,3,6,7,8-HxCDF	ug/L	NA	NA	NA
2,3,4,6,7,8-HxCDF	ug/L	NA	NA	NA
1,2,3,7,8,9-HxCDF	ug/L	NA	NA	NA
Total HxCDF	ug/L	NA	NA	NA
1,2,3,4,6,7,8-HpCDF	ug/L	NA	NA	NA
1,2,3,4,7,8,9-HpCDF	ug/L	NA	NA	NA
Total HpCDF	ug/L	NA	NA	NA
OCDF	ug/L	NA	NA	NA
<b>Metals</b>				
Silver	mg/L	<0.01	<0.01	<0.01
Aluminum	mg/L	<0.2	<0.2	<0.2
Arsenic	mg/L	<0.01	<0.01	<0.01
Barium	mg/L	0.4805	0.4	0.52
Beryllium	mg/L	<0.004	<0.004	<0.004
<b>Calcium</b>	mg/L	<b>268</b>	<b>260</b>	<b>280</b>
Cadmium	mg/L	<0.005	<0.005	<0.005
Cobalt	mg/L	<0.01	<0.01	<0.01
Chromium	mg/L	<0.01	<0.01	<0.01
Copper	mg/L	0.02125	0.02	0.035
<b>Iron</b>	mg/L	<b>18.9</b>	<b>17</b>	<b>20</b>
Mercury	mg/L	<0.0002	<0.0002	<0.0002
Potassium	mg/L	14.6	14	15
Magnesium	mg/L	63	61	65
Manganese	mg/L	2.8	2.6	2.9
Sodium	mg/L	124	120	150
Nickel	mg/L	<0.04	<0.04	<0.04
Lead	mg/L	<0.005	<0.005	<0.005
Antimony	mg/L	<0.02	<0.02	<0.02
Selenium	mg/L	<0.01	<0.01	<0.01
Thallium	mg/L	<0.01	<0.01	<0.01
Vanadium	mg/L	<0.01	<0.01	<0.01
<b>Zinc</b>	mg/L	<b>0.048</b>	<b>0.041</b>	<b>0.064</b>

## Notes:

- (a) If Average, Minimum, and Maximum are the same then there were no detections beyond the MDL.
- (b) If there are "<" before each number, then there were no detections above the MDL but the detection limits were different on some samples.
- (c) Parameters in **BOLD** are constituents that were detected at >1 ppb.

TABLE 4-4. COMPARISON OF ANALYTICAL RESULTS FOR SPLIT COMPOSITE SAMPLES

PARAMETER	UNITS	POINT A									Point C								
		5/19/03			5/20/03			5/21/03			5/19/03			5/20/03			5/21/03		
		STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff
1,2,4-Trichlorobenzene	ug/l	<100	24		<100	0		<100	21		<10	0		<10	0		<10	0	
1,2-Dichlorobenzene	ug/l	450	378	17.4%	480	443	8.0%	430	212	67.9%	<10	0		<10	0		<10	0	
1,2-Diphenylhydrazine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
1,3-Dichlorobenzene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
1,4-Dichlorobenzene	ug/l	420	414	1.4%	390	345	12.2%	360	91	119.3%	<10	0		<10	0		<10	0	
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/l	<100			<100			<100			<10			<10			<10		
2,4,5-Trichlorophenol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2,4,6-Trichlorophenol	ug/l	<100	94		<100	0		<100	0		<10	0		<10	0		<10	0	
2,4-Dichlorophenol	ug/l	220	322	37.6%	250	299	17.9%	230	212	8.1%	<10	0		<10	0		<10	0	
2,4-Dimethylphenol	ug/l	<100	187		<100	0		<100	0		<10	0		<10	0		<10	0	
2,4-Dinitrophenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
2,4-Dinitrotoluene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2,6-Dinitrotoluene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2-Chloroaniline	ug/l	32,000	35,500	10.4%	26,000	29,600	12.9%	24000	14,100	52.0%	<10	2		<10	0		<10	1	
2-Chloronaphthalene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2-Chlorophenol	ug/l	460	724	44.6%	<350	409		270	176		<10	0		<10	0		<10	0	
2-Methylnaphthalene	ug/l	<100			<100			<100			<10			<10			<10		
2-Methylphenol (o-Cresol)	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2-Nitroaniline	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
2-Nitrochlorobenzene	ug/l	4200	944	126.6%	12000	9,940	18.8%	18000	4,800	115.8%	<10	0		<10	0		<10	0	
2-Nitrophenol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
3,3'-Dichlorobenzidine	ug/l	<200	0		<200	0		<200	0		<20	0		<20	0		<20	0	
3-Chloroaniline	ug/l	20000	11,100	57.2%	21000	9,830	72.5%	20000	3,970	133.8%	<10	0		<10	0		<10	0	
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	500	621	21.6%	440	397	10.3%	320	215	39.3%	<10	0		<10	0		<10	0	
3-Nitroaniline	ug/l	<500			<500			<500			<50			<50			<50		
3-Nitrochlorobenzene	ug/l	<2000	302		<2500	775		1000	700	35.3%	<10	0		<10	0		<10	0	
4,6-Dinitro-2-methylphenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
4-Bromophenylphenyl ether	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
4-Chloro-2,6-Dinitrophenol	ug/l	<40000	0		<40000	0		<20000	0		<200	0		<200	0		<200	0	
4-Chloro-3-methylphenol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
4-Chloroaniline	ug/l	19000	23,300	20.3%	16000	17,900	11.2%	13000	6,280	69.7%	<20	2		<20	0		<20	0	
4-Chlorophenol	ug/l	4200			4200			3300			<10			<10			<10		
4-Chlorophenylphenyl ether	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
4-Nitroaniline	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
4-Nitrochlorobenzene	ug/l	2000	2,990	39.7%	3800	2,900	26.9%	5200	1,620	105.0%	<10	0		<10	0		<10	0	
4-Nitrophenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
Acenaphthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Acenaphthylene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Aniline	ug/l	33000	43,600	27.7%	25000	33,500	29.1%	23000	18,800	20.1%	<20	3		<20	0		<20	0	
Anthracene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzidine	ug/l	<16000	0		<20000	0		<8000	0		<80	0		<80	0		<80	0	
Benzo(a)anthracene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	

TABLE 4-4. COMPARISON OF ANALYTICAL RESULTS FOR SPLIT COMPOSITE SAMPLES

PARAMETER	UNITS	POINT A									Point C								
		5/19/03			5/20/03			5/21/03			5/19/03			5/20/03			5/21/03		
		STL	ABRTF	% Diff															
Benzo(a)pyrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzo(b)fluoranthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzo(g,h,i)perylene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzo(k)fluoranthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzoic acid	ug/l	740			780			760			<50			<50			<50		
Benzyl alcohol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
bis(2-Chloroethoxy)methane	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
bis(2-Chloroethyl)ether	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
bis(2-Ethylhexyl)phthalate	ug/l	<100	35		<100	0		<100	0		<10	0		<10	0		<10	0	
Butylbenzylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Carbazole	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Chrysene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dibenzo(a,h)anthracene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dibenzofuran	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Diethylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dimethylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Di-n-butylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Di-n-octylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dinoseb	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Fluoranthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Fluorene	ug/l	<100	12		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachlorobenzene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachlorobutadiene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachlorocyclopentadiene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachloroethane	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Indeno(1,2,3-cd)pyrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Isophorone	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Naphthalene	ug/l	1500	0		<100	0		840	0		<10	0		<10	0		<10	0	
Nitrobenzene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
N-Nitrosodimethylamine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
N-Nitroso-di-n-propylamine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
N-Nitrosodiphenylamine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Pentachlorophenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
Phenanthrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Phenol	ug/l	6500	7,860	18.9%	4500	4,720	4.8%	3900	2,690	36.7%	<10	0		<10	0		<10	0	
Pyrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Pyridine	ug/l	<500			<500			<500			<50			<50			<50		

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>Miscellaneous</b>							
Total Organic Carbon	mg/l	140	19	130	110	14	14
Chemical Oxygen Demand	mg/l	596	65	501	425	40	65
<b>Volatiles</b>							
1,1-Dichloroethene	ug/l	<20	<10	<20	<20	<1	<1
1,2-Dichloroethene (total)	ug/l	<100	<50	<100	<100	<5	<5
2-Butanone (MEK)	ug/l	<200	<100	<200	260	<10	<10
2-Hexanone	ug/l	<200	<100	<200	<200	<10	<10
Benzene	ug/l	390	<10	440	<20	<1	<1
4-Methyl-2-pentanone (MIBK)	ug/l	<200	<100	<200	<200	<10	<10
Bromoform	ug/l	<20	<10	<20	<20	<1	<1
Carbon tetrachloride	ug/l	<20	<10	<20	<20	<1	<1
Chlorobenzene	ug/l	2800	<10	3000	<20	<1	<1
cis-1,3-Dichloropropene	ug/l	<20	<10	<20	<20	<1	<1
trans-1,3-Dichloropropene	ug/l	<20	<10	<20	<20	<1	<1
Chloroethane	ug/l	24	<10	24	<20	<1	<1
2-Chloroethylvinyl ether	ug/l	<200	<100	<200	<200	<10	<10
Chloroform	ug/l	<20	<10	<20	<20	<1	<1
1,1-Dichloroethane	ug/l	<20	<10	<20	<20	<1	<1
1,2-Dichloroethane	ug/l	<20	<10	<20	<20	<1	<1
1,2-Dichloropropane	ug/l	<20	<10	<20	<20	<1	<1
Ethylbenzene	ug/l	74	<10	92	<20	<1	<1
Methylene chloride (Dichloromethane)	ug/l	<100	<50	<100	<100	<1	<1
1,1,2,2-Tetrachloroethane	ug/l	<20	<10	<20	<20	<1	<1
Toluene	ug/l	850	<10	940	<20	<1	<1
trans-1,2-Dichloroethene	ug/l	<20	<10	<20	<20	<1	<1
1,1,1-Trichloroethane	ug/l	<20	<10	<20	<20	<1	<1
1,1,2-Trichloroethane	ug/l	<20	<10	<20	<20	<1	<1
Vinyl chloride	ug/l	22	<10	23	<20	<1	<1
Acetone	ug/l	4100	2900	3600	3600	100	150
Bromodichloromethane	ug/l	<20	<10	<20	<20	<1	<1

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>Volatiles (continued)</b>							
Bromomethane (Methyl bromide)	ug/l	<20	<10	<20	<20	<1	<1
Chloromethane	ug/l	<20	<10	<20	<20	<1	<1
Carbon disulfide	ug/l	<20	<10	<20	<20	<1	<1
Dibromochloromethane	ug/l	<20	<10	<20	<20	<1	<1
Styrene	ug/l	<20	<10	<20	<20	<1	<1
Tetrachloroethene	ug/l	<20	<10	<20	<20	<1	<1
Trichloroethene	ug/l	28	<10	31	<20	<1	<1
Xylenes, Total	ug/l	420	20	500	<40	<2	<2
<b>Semi-Volatiles</b>							
2-Chlorophenol	ug/l	430	<10	290	<200	<10	<10
Acenaphthene	ug/l	<100	<10	<100	<200	<10	<10
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/l	<100	<10	<100	<200	<10	<10
2-Nitroaniline	ug/l	<500	<50	<500	<1000	<50	<50
2-Chloroaniline	ug/l	33000	<10	25000	8000	<10	<10
2-Methylnaphthalene	ug/l	<100	<10	<100	<200	<10	<10
2-Methylphenol (o-Cresol)	ug/l	<100	<10	<100	<200	<10	<10
2,4-Dichlorophenol	ug/l	270	<10	300	<200	<10	<10
Acenaphthylene	ug/l	<100	<10	<100	<200	<10	<10
3-Nitroaniline	ug/l	<500	<50	<500	<1000	<50	<50
2,4-Dimethylphenol	ug/l	<100	<10	<100	<200	<10	<10
Anthracene	ug/l	<100	<10	<100	<200	<10	<10
4,6-Dinitro-2-methylphenol	ug/l	<500	<50	<500	<1000	<50	<50
4-Chloroaniline	ug/l	20000	<20	15000	3200	<20	<20
4-Chloro-3-methylphenol	ug/l	<100	<10	<100	<200	<10	<10
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	500	<10	350	240	<10	<10
4-Nitroaniline	ug/l	<500	<50	<500	<1000	<50	<50
2,4-Dinitrophenol	ug/l	<500	<50	<500	<1000	<50	<50
2-Nitrophenol	ug/l	<100	<10	<100	<200	<10	<10
Benzo(a)pyrene	ug/l	<100	<10	<100	<200	<10	<10
4-Nitrophenol	ug/l	<500	<50	<500	<1000	<50	<50
Aniline	ug/l	28000	<20	24000	6000	<20	<20

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>Semi-Volatiles (continued)</b>							
Benzo(a)anthracene	ug/l	<100	<10	<100	<200	<10	<10
Benzo(b)fluoranthene	ug/l	<100	<10	<100	<200	<10	<10
Diethylphthalate	ug/l	<100	<10	<100	<200	<10	<10
Pyridine	ug/l	<500	<50	<500	<1000	<50	<50
2,4,5-Trichlorophenol	ug/l	<100	<10	<100	<200	<10	<10
Benzo(g,h,i)perylene	ug/l	<100	<10	<100	<200	<10	<10
Pentachlorophenol	ug/l	<500	<50	<500	<1000	<50	<50
Phenol	ug/l	5800	<10	3800	3300	<10	<10
bis(2-Chloroethoxy)methane	ug/l	<100	<10	<100	<200	<10	<10
2,4,6-Trichlorophenol	ug/l	<100	<10	100	<200	<10	<10
bis(2-Chloroethyl)ether	ug/l	<100	<10	<100	<200	<10	<10
bis(2-Ethylhexyl)phthalate	ug/l	<100	<10	<100	<200	<10	<10
4-Bromophenylphenyl ether	ug/l	<100	<10	<100	<200	<10	<10
Butylbenzylphthalate	ug/l	<100	<10	<100	<200	<10	<10
2-Chloronaphthalene	ug/l	<100	<10	<100	<200	<10	<10
4-Chlorophenylphenyl ether	ug/l	<100	<10	<100	<200	<10	<10
Chrysene	ug/l	<100	<10	<100	<200	<10	<10
Dibenzo(a,h)anthracene	ug/l	<100	<10	<100	<200	<10	<10
1,2-Dichlorobenzene	ug/l	550	<10	490	<200	<10	<10
1,3-Dichlorobenzene	ug/l	<100	<10	<100	<200	<10	<10
1,4-Dichlorobenzene	ug/l	460	<10	400	<200	<10	<10
3,3'-Dichlorobenzidine	ug/l	<200	<20	<200	<400	<20	<20
Dimethylphthalate	ug/l	<100	<10	<100	<200	<10	<10
Di-n-butylphthalate	ug/l	<100	<10	<100	<200	<10	<10
2,4-Dinitrotoluene	ug/l	<100	<10	<100	<200	<10	<10
2,6-Dinitrotoluene	ug/l	<100	<10	<100	<200	<10	<10
Di-n-octylphthalate	ug/l	<100	<10	<100	<200	<10	<10
1,2-Diphenylhydrazine	ug/l	<100	<10	<100	<200	<10	<10
Fluoranthene	ug/l	<100	<10	<100	<200	<10	<10
Fluorene	ug/l	<100	<10	<100	<200	<10	<10
Hexachlorobenzene	ug/l	<100	<10	<100	<200	<10	<10

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>Semi-Volatiles (continued)</b>							
Hexachlorobutadiene	ug/l	<100	<10	<100	<200	<10	<10
Hexachlorocyclopentadiene	ug/l	<100	<10	<100	<200	<10	<10
Hexachloroethane	ug/l	<100	<10	<100	<200	<10	<10
Indeno(1,2,3-cd)pyrene	ug/l	<100	<10	<100	<200	<10	<10
Isophorone	ug/l	<100	<10	<100	<200	<10	<10
Naphthalene	ug/l	1400	<10	1000	<200	<10	<10
Nitrobenzene	ug/l	<100	<10	<100	<200	<10	<10
N-Nitrosodimethylamine	ug/l	<100	<10	<100	<200	<10	<10
N-Nitrosodiphenylamine	ug/l	<100	<10	<100	<200	<10	<10
Phenanthrene	ug/l	<100	<10	<100	<200	<10	<10
Pyrene	ug/l	<100	<10	<100	<200	<10	<10
1,2,4-Trichlorobenzene	ug/l	<100	<10	<100	<200	<10	<10
Benzo(k)fluoranthene	ug/l	<100	<10	<100	<200	<10	<10
Benzoic acid	ug/l	<500	<50	1100	<1000	<50	<50
Benzyl alcohol	ug/l	<100	<10	<100	<200	<10	<10
Carbazole	ug/l	<100	<10	<100	<200	<10	<10
Dibenzofuran	ug/l	<100	<10	<100	<200	<10	<10
Dinoseb	ug/l	<100	<10	<100	<200	<10	<10
N-Nitroso-di-n-propylamine	ug/l	<100	<10	<100	<200	<10	<10
2-Nitrochlorobenzene	ug/l	13000	<10	24000	13000	<10	<10
3-Chloroaniline	ug/l	29000	<10	15000	9600	<10	<10
3-Nitrochlorobenzene	ug/l	<2000	<10	<2000	<1000	<10	<10
4-Chloro-2,6-Dinitrophenol	ug/l	<40000	<200	<40000	<20000	<200	<200
4-Chlorophenol	ug/l	5900	<10	3900	1900	<10	<10
4-Nitrochlorobenzene	ug/l	3600	<10	6300	4000	<10	<10
Benzidine	ug/l	<16000	<80	<16000	<8000	<80	<80
<b>Pesticides</b>							
Aldrin	ug/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-BHC	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
beta-BHC	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
gamma-BHC (Lindane)	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>Pesticides (continued)</b>							
delta-BHC	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Chlordane (technical)	ug/l	<0.50	<0.50	<0.5	<0.5	<0.50	<0.50
4,4'-DDT	ug/l	<0.10	<0.10	<0.1	<0.1	<0.10	<0.10
Endosulfan I	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Endosulfan II	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
4,4'-DDE	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
4,4'-DDD	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Dieldrin	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Endosulfan sulfate	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Endrin	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Heptachlor	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Heptachlor epoxide	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Toxaphene	ug/l	<5.00	<5.0	<5	<5.0	<5	<5
alpha-Chlordane	ug/l	<0.05	<0.1	<0.05	<0.1	<0.05	<0.05
Endrin ketone	ug/l	<0.10	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	ug/l	<0.05	<0.1	<0.05	<0.1	<0.05	<0.05
Methoxychlor	ug/l	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5
<b>Herbicides</b>							
2,4,5-TP (Silvex)	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-DB	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D	ug/l	63	<0.5	57	58	<0.5	<0.5
2,4,5-T	ug/l	5.2P	<0.5	4.8E	5.9EP	<0.5	<0.5
Pentachlorophenol	ug/l	3.2	<1.0	2.6	3.1	<1	<1
Dalapon	ug/l	<120	<120	<120	<120	<120	<120
Dicamba	ug/l	<1	<1.2	<1.2	<1.2	<1.2	<1.2
Dichloroprop	ug/l	88E	<6.0	69E	74E	<6	<6
MCPP[(4-chloro-2-methylphenoxy)-acetic acid]	ug/l	<120	<120	<120	<120	<120	<120
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/l	<120	<120	<120	<120	<120	<120

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>PCBs</b>							
Decachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Monochlorobiphenyl	ug/l	3.7	<0.1	<0.1	<0.1	<0.1	<0.1
Nonachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Octachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Pentachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tetrachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor-1242	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1254	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1221	ug/l	<2	<2	<2	<2.0	<2	<2
Aroclor-1232	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1248	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1260	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1016	ug/l	<1	<1	<1	<1.0	<1	<1
<b>Metals</b>							
Silver	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	mg/l	<0.20	<0.20	<0.2	<0.20	<0.2	<0.2
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.47	0.33	0.5	0.27	0.43	0.43
Beryllium	mg/l	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Calcium	mg/l	270	260	270	120	260	260
Cadmium	mg/l	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01
Cobalt	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/l	<0.02	<0.02	<0.03	<0.02	<0.02	<0.02
Iron	mg/l	19	<0.05	20	16	17	17
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Potassium	mg/l	15	15	14	14	14	14

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

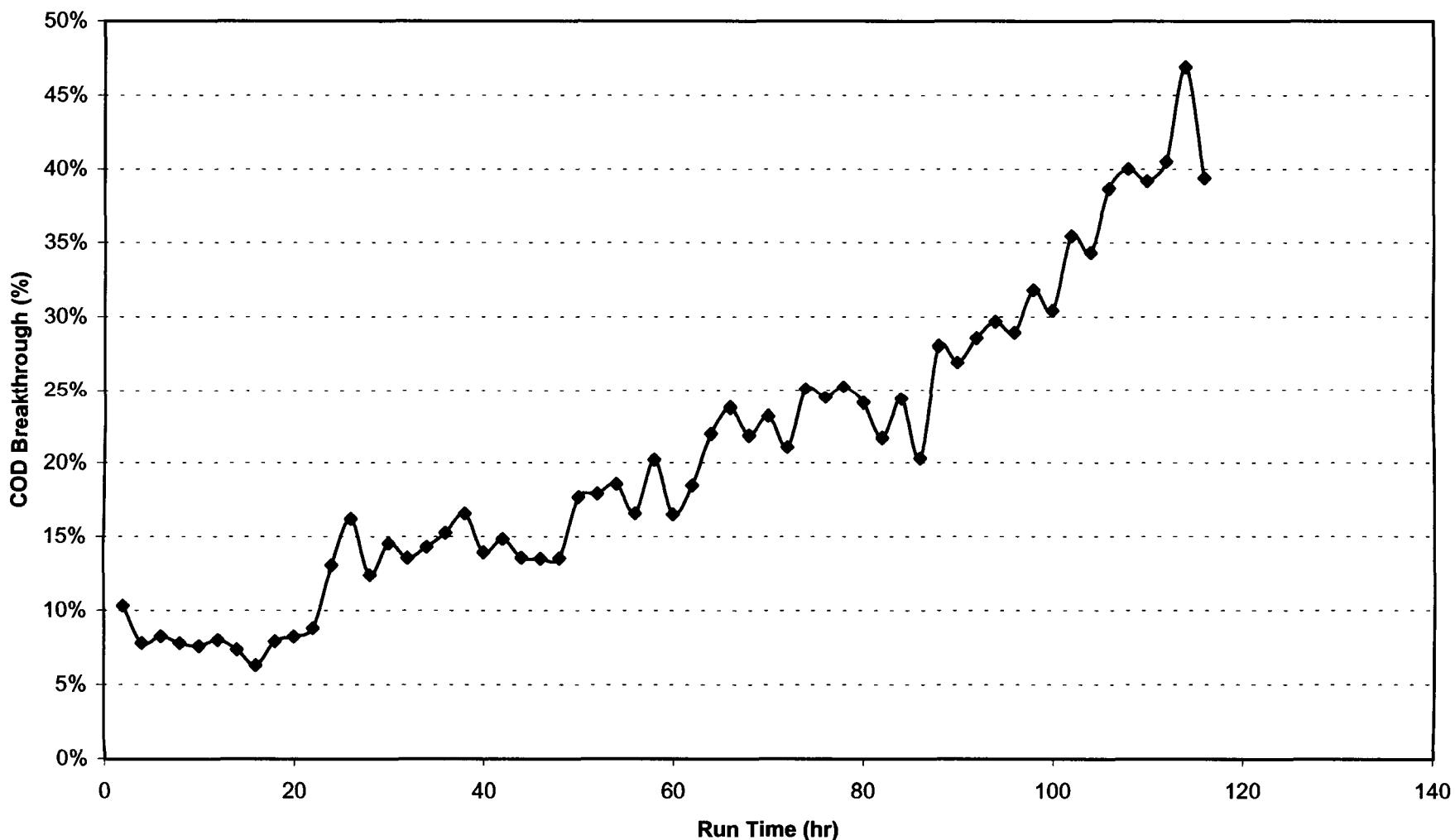
PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
<b>Metals (continued)</b>							
Magnesium	mg/l	64	61	62	61	62	62
Manganese	mg/l	2.8	2.7	2.8	0.71	2.8	2.7
Sodium	mg/l	130	130	120	120	120	120
Nickel	mg/l	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Lead	mg/l	<0.01	<0.01	<0.005	0.0054	<0.01	<0.01
Antimony	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/l	0.042	0.03	0.061	0.045	<0.02	<0.02

Qualifiers:

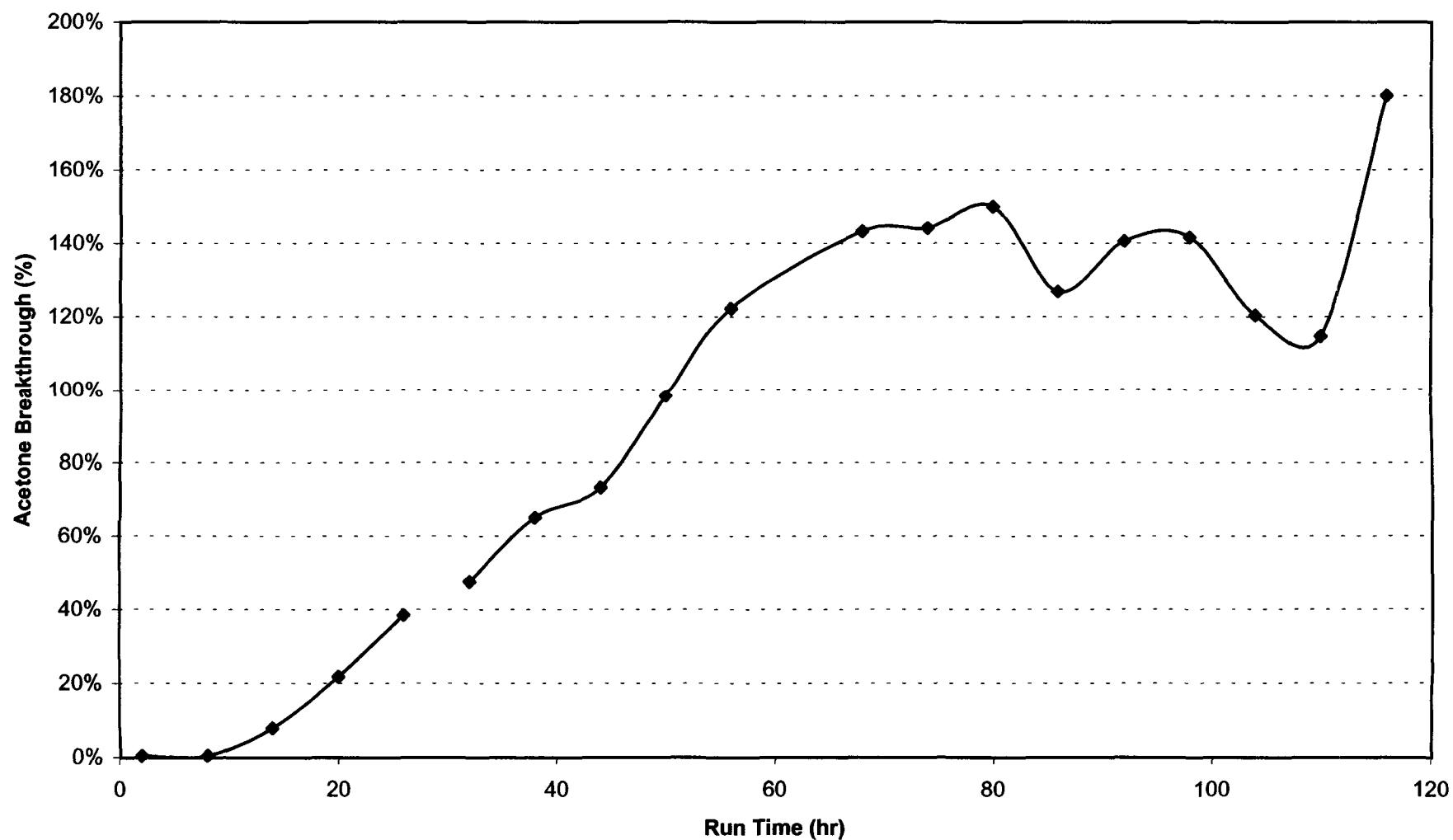
E = Estimated value

P = Presence of parameter confirmed but accuracy of result suspect

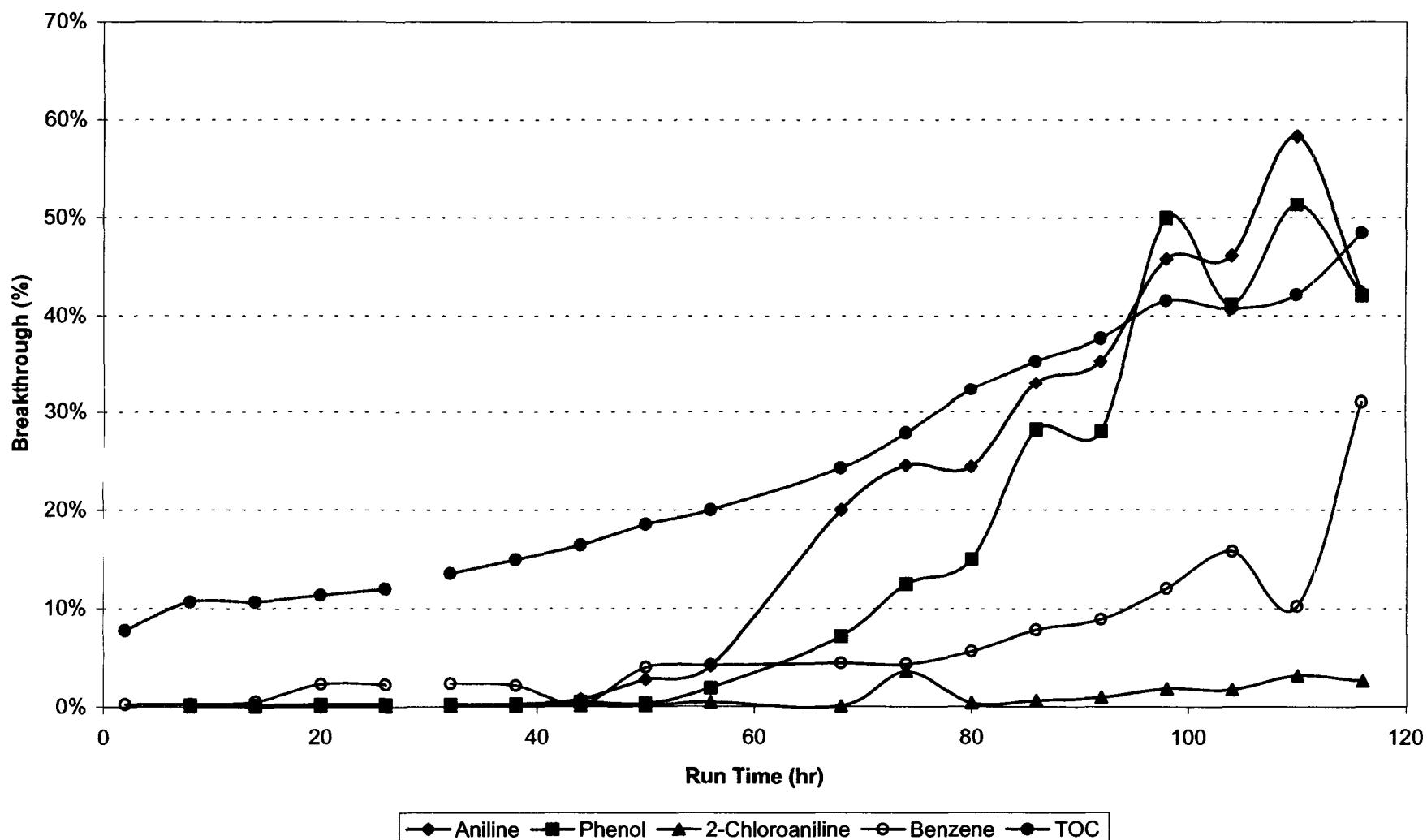
**FIGURE 4-1. COD BREAKTHROUGH CURVE  
FOR PILOT SYSTEM LEAD COLUMN**



**FIGURE 4-2. ACETONE BREAKTHROUGH CURVE  
FOR PILOT SYSTEM LEAD COLUMN**



**FIGURE 4-3. TOC AND SPECIFIC ORGANICS BREAKTHROUGH CURVES FOR PILOT SYSTEM LEAD COLUMN**





## **5.0 CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 GAC TREATMENT**

The pilot system at the Krummrich site operated nearly twice as long as the original projection of 60 hours based on the preliminary process design. This increased run time can be attributed to the lower influent TOC concentration – an average of 141 mg/L versus the projected 300 mg/L. Based on the flow and TOC data collected during the study, Calgon DSR-C activated carbon has a capacity of 0.103 lb TOC per lb of GAC for the Krummrich Area 2 groundwater. Capacity calculations are provided in Table 5-1. Because the lead column was not run to total exhaustion, this capacity represents a conservative estimate for projecting GAC usage in the full-scale system, should it be implemented in the future. If the groundwater TOC concentration remains constant, the GAC capacity can also be expressed as 8.7 lb of GAC exhausted per 1,000 gallons of treated groundwater. Assuming an average forward flow of 600 gpm for the full-scale system, coupled with a lead carbon column changeout of 20,000 lb per train, a changeout would be required every 64 hours (2.7 days). The time between changeouts may be increased if the lead columns are run to complete exhaustion and the lag column effluent closely monitored, as the capacities shown above and in Table 5-1 are calculated based on only 45-50 percent breakthrough of the lead column.

The effluent quality achieved following lead-lag carbon treatment is shown in Table 5-2. As expected, for a polar, volatile, low molecular weight compound carbon did not effectively remove acetone from the groundwater.

### **5.2 COMPARISON OF PILOT SYSTEM AND RSSCT**

TOC data were not tracked during operation of the RSSCT due to limited quantities of available effluent; therefore, the TOC capacity for the unit cannot be determined. However, the design of the RSSCT can be used to compare COD breakthrough observed in both the bench-scale and pilot scale units. From the design parameters in Table 3-2, one hour of RSSCT operation correlates to 56 hours of pilot system operation. The target value of 50 percent COD breakthrough occurred in the RSSCT after 110 minutes of operation, which equates to 102 hours of pilot system operation.

However, the pilot system was operated for 116 hours (i.e. 14 percent longer) and approached but did not achieve 50 percent breakthrough of COD. This discrepancy between the projected and actual run times for the pilot system is likely due to the high COD concentration in the RSSCT influent relative to the pilot system. Influent for the RSSCT was collected early in the operation of the pilot system, before the influent COD stabilized in the range of 480-500 mg/L. As a result, the influent COD was approximately 20 percent higher for the RSSCT than for the pilot system. This increase in COD would result in a more rapid saturation of the activated carbon in the small-scale column, thus causing breakthrough to occur more quickly than in the pilot system. However, the projected run time for the RSSCT agrees with the observed operation of the pilot system within 15 percent, suggesting that the RSSCT can be used to predict full-scale operations with a reasonable degree of accuracy. The RSSCT was operated for 3 hours. During this time, approximately 76 percent of the influent COD had broken through. Thus, assuming that the RSSCT operation can reasonably predict full-scale performance, the full-scale system would require a 20,000 lb carbon changeout every 4 days rather than every 2.7 days as estimated in Section 5.1.

### **5.3 APPLICABILITY OF OZONATION**

Results from ozonation of the pilot system influent indicate that portions of the groundwater TOC can be treated by ozone. However, the results shown in Section 4.2 indicate that ozone will treat the various organic compounds in the groundwater at varying degrees of effectiveness. Acetone, which achieved rapid breakthrough in the carbon bed, was not removed by ozone. For the ozone dose studied (3 lb per lb of COD), the observed TOC removal of 15 percent would not appreciably lower the carbon demand. An increase in the ozone dosage or a combined treatment of ozone and ultraviolet light catalyst would likely increase this removal efficiency. The capital and operating costs of an ozone or ozone-UV pretreatment system would need to be compared to the savings obtained by lowering the carbon usage rate.

The effectiveness of ozone as a post-treatment technology could not be determined due to the limited number of detectable organics in the pilot system effluent. However, the limited number of detectable organics in the effluent suggests that post-treatment would not be necessary to achieve desired effluent quality.

**TABLE 5-1. CALCULATION OF ACTIVATED CARBON CAPACITY**

Run Time (hr)	Total Flow (gal)	Influent TOC (mg/L)	Effluent TOC (mg/L)	TOC Removed	
				(mg/L)	(lb)
0	5,760				
2	41,270	180	14	166	49.2
8	113,960	150	16	134	91.0
14	187,960	150	16	134	82.7
20	260,510	150	17	133	80.5
26	331,571	150	18	132	78.3
32	403,796	140	19	121	72.9
38	474,128	140	21	119	69.8
44	544,400	140	23	117	68.6
50	614,420	140	26	114	66.6
56	687,526	140	28	112	68.3
62	759,620	140	31	109	65.6
68	830,454	140	34	106	62.7
74	902,160	140	39	101	60.4
80	973,836	130	42	88	52.6
86	1,046,273	130	46	84	50.8
92	1,115,180	130	49	81	46.6
98	1,184,322	130	54	76	43.8
104	1,252,342	140	57	83	47.1
110	1,317,700	140	59	81	44.2
116	1,384,330	130	63	67	37.3

TOTAL TOC REMOVED (lb): 1,239  
TOTAL GAC LOAD (lb): 12,000  
GAC CAPACITY (lb TOC/lb GAC): 0.103  
GAC CAPACITY (lb GAC/1,000 gal): 8.70

**TABLE 5-2. EFFLUENT QUALITY ACHIEVED<sup>(a)</sup>**

PARAMETER	UNITS	RESULT <sup>(b)</sup>
<b>Miscellaneous</b>		
TKN	mg/L	9.4
Ammonia	mg/L	9.0
BOD	mg/L	30
<b>Volatiles</b>		
1,1-Dichloroethene	ug/L	ND
1,2-Dichloroethene (total)	ug/L	ND
2-Butanone (MEK)	ug/L	ND
Benzene	ug/L	ND
4-Methyl-2-pentanone (MIBK)	ug/L	ND
Acrolein	ug/L	ND
Acrylonitrile	ug/L	ND
Bromoform	ug/L	ND
Carbon tetrachloride	ug/L	ND
Chlorobenzene	ug/L	ND
cis-1,3-Dichloropropene	ug/L	ND
trans-1,3-Dichloropropene	ug/L	ND
Chloroethane	ug/L	ND
2-Chloroethylvinyl ether	ug/L	ND
Chloroform	ug/L	ND
1,1-Dichloroethane	ug/L	ND
1,2-Dichloroethane	ug/L	ND
1,2-Dichloropropane	ug/L	ND
1,3-Dichloropropene (total)	ug/L	ND
Ethylbenzene	ug/L	ND
Methylene chloride (Dichloromethane)	ug/L	2.9
1,1,2,2-Tetrachloroethane	ug/L	ND
Toluene	ug/L	0.42
1,1,1-Trichloroethane	ug/L	ND
1,1,2-Trichloroethane	ug/L	ND
Vinyl chloride	ug/L	ND
Acetone <sup>(c)</sup>	ug/L	6,000
Bromodichloromethane	ug/L	ND
Bromomethane (Methyl bromide)	ug/L	ND
Chloromethane	ug/L	ND
Carbon disulfide	ug/L	ND
Dibromochloromethane	ug/L	ND
Tetrachloroethene	ug/L	ND
Trichloroethene	ug/L	ND
m and p-Xylene	ug/L	ND
o-Xylene	ug/L	ND
Xylenes, Total	ug/L	ND

**TABLE 5-2. EFFLUENT QUALITY ACHIEVED<sup>(a)</sup>**

PARAMETER	UNITS	RESULT <sup>(b)</sup>
<b>Semi-Volatiles</b>		
2-Chlorophenol	ug/L	ND
Acenaphthene	ug/L	ND
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/L	ND
2-Nitroaniline	ug/L	ND
2-Chloroaniline	ug/L	1
2-Methylphenol (o-Cresol)	ug/L	ND
2,4-Dichlorophenol	ug/L	ND
Acenaphthylene	ug/L	ND
2,4-Dimethylphenol	ug/L	ND
Anthracene	ug/L	ND
4,6-Dinitro-2-methylphenol	ug/L	ND
4-Chloroaniline	ug/L	ND
4-Chloro-3-methylphenol	ug/L	ND
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/L	ND
4-Nitroaniline	ug/L	ND
2,4-Dinitrophenol	ug/L	ND
2-Nitrophenol	ug/L	ND
Benzo(a)pyrene	ug/L	ND
4-Nitrophenol	ug/L	ND
Aniline	ug/L	5
Benzo(a)anthracene	ug/L	ND
Benzo(b)fluoranthene	ug/L	ND
Diethylphthalate	ug/L	ND
2,4,5-Trichlorophenol	ug/L	ND
Benzo(g,h,i)perylene	ug/L	ND
Pentachlorophenol	ug/L	ND
Phenol	ug/L	ND
bis(2-Chloroethoxy)methane	ug/L	ND
2,4,6-Trichlorophenol	ug/L	ND
bis(2-Chloroethyl)ether	ug/L	ND
bis(2-Ethylhexyl)phthalate	ug/L	ND
4-Bromophenylphenyl ether	ug/L	ND
Butylbenzylphthalate	ug/L	ND
2-Chloronaphthalene	ug/L	ND
4-Chlorophenylphenyl ether	ug/L	ND
Chrysene	ug/L	ND
Dibenzo(a,h)anthracene	ug/L	ND
1,2-Dichlorobenzene	ug/L	ND
1,3-Dichlorobenzene	ug/L	ND

**TABLE 5-2. EFFLUENT QUALITY ACHIEVED<sup>(a)</sup>**

PARAMETER	UNITS	RESULT <sup>(b)</sup>
1,4-Dichlorobenzene	ug/L	ND
3,3'-Dichlorobenzidine	ug/L	ND
Dimethylphthalate	ug/L	ND
2,4-Dinitrotoluene	ug/L	ND
2,6-Dinitrotoluene	ug/L	ND
Di-n-octylphthalate	ug/L	ND
1,2-Diphenylhydrazine	ug/L	ND
Fluoranthene	ug/L	ND
Fluorene	ug/L	ND
Hexachlorobenzene	ug/L	ND
Hexachlorobutadiene	ug/L	ND
Hexachlorocyclopentadiene	ug/L	ND
Hexachloroethane	ug/L	ND
Indeno(1,2,3-cd)pyrene	ug/L	ND
Isophorone	ug/L	ND
Naphthalene	ug/L	ND
Nitrobenzene	ug/L	ND
N-Nitrosodimethylamine	ug/L	ND
N-Nitrosodiphenylamine	ug/L	ND
Phenanthrene	ug/L	ND
Pyrene	ug/L	ND
1,2,4-Trichlorobenzene	ug/L	ND
Benzo(k)fluoranthene	ug/L	ND
Dinoseb	ug/L	ND
N-Nitroso-di-n-propylamine	ug/L	ND
2-Nitrochlorobenzene	ug/L	ND
3-Chloroaniline	ug/L	ND
3-Nitrochlorobenzene	ug/L	ND
4-Chloro-2,6-Dinitrophenol	ug/L	ND
4-Nitrochlorobenzene	ug/L	ND
Benzidine	ug/L	ND
<b>Pesticides</b>		
Aldrin	ug/L	ND
alpha-BHC	ug/L	ND
beta-BHC	ug/L	ND
gamma-BHC (Lindane)	ug/L	ND
delta-BHC	ug/L	ND
Chlordane (technical)	ug/L	ND
4,4'-DDT	ug/L	ND
Endosulfan I	ug/L	ND
Endosulfan II	ug/L	ND

**TABLE 5-2. EFFLUENT QUALITY ACHIEVED<sup>(a)</sup>**

PARAMETER	UNITS	RESULT <sup>(b)</sup>
4,4'-DDE	ug/L	ND
4,4'-DDD	ug/L	ND
Dieldrin	ug/L	ND
Endosulfan sulfate	ug/L	ND
Endrin	ug/L	ND
Endrin aldehyde	ug/L	ND
Heptachlor	ug/L	ND
Heptachlor epoxide	ug/L	ND
Toxaphene	ug/L	ND
Methoxychlor	ug/L	ND
<b>Herbicides</b>		
2,4,5-TP (Silvex)	ug/L	ND
2,4-D	ug/L	ND
2,4,5-T	ug/L	ND
Pentachlorophenol	ug/L	ND
Dalapon	ug/L	ND
<b>PCBs</b>		
Aroclor-1242	ug/L	ND
Aroclor-1254	ug/L	ND
Aroclor-1221	ug/L	ND
Aroclor-1232	ug/L	ND
Aroclor-1248	ug/L	ND
Aroclor-1260	ug/L	ND
Aroclor-1016	ug/L	ND
<b>Metals</b>		
Silver	mg/L	ND
Aluminum	mg/L	ND
Arsenic	mg/L	ND
Barium	mg/L	0.376
Beryllium	mg/L	ND
Calcium	mg/L	ND
Cadmium	mg/L	ND
Cobalt	mg/L	ND
Chromium	mg/L	ND
Copper	mg/L	ND
Iron	mg/L	18
Mercury	mg/L	ND
Potassium	mg/L	ND
Magnesium	mg/L	ND
Manganese	mg/L	2.9
Sodium	mg/L	ND

**TABLE 5-2. EFFLUENT QUALITY ACHIEVED<sup>(a)</sup>**

PARAMETER	UNITS	RESULT <sup>(b)</sup>
Nickel	mg/L	ND
Lead	mg/L	ND
Antimony	mg/L	ND
Selenium	mg/L	ND
Thallium	mg/L	ND
Vanadium	mg/L	ND
Zinc	mg/L	0.04

Notes:

(a) Based on ABRTF effluent analysis after lag column May 21, 2003 (except acetone, see note c).

(b) ND = Non Detect

(c) Data from STL effluent analysis after lag column May 24, 2003.



## **ATTACHMENT 1**

### **AMERICAN BOTTOMS REGIONAL TREATMENT FACILITY TEMPORARY USER DISCHARGE PERMIT**



**AMERICAN BOTTOMS  
REGIONAL WASTEWATER TREATMENT FACILITY**

1 AMERICAN BOTTOMS ROAD

SAUGET, ILLINOIS 62201-1075

(618) 337-1710

FAX (618) 337-8919

May 9, 2003

**HAND DELIVERED**

Mr. Richard S. Williams  
Project Manager, Sauget Sites Project  
Solutia Inc.  
500 Monsanto Avenue  
Sauget, IL 62206-1198

RE: Draft Permit No. 03-138

Dear Mr. Williams:

Herewith is the draft Wastewater Discharge Permit No.03-138 for your review.

We have modified the draft permit per your comments in the May 5<sup>th</sup> meeting and have also modified section part 4.E to include the following changes.

1. E.3 - Monitoring Location A was added for mercury and cyanide monitoring to remain consistent with E.12;
  - Monitoring for parameters that reference part 4.C were removed and consolidated to parameters in part E.12;
  - COD monitoring was removed from Location C;
2. The monitoring frequency language in section E.5 was modified for Solutia to daily for the first, third, seventh and every seven days thereafter. Language was added to clarify the first day of discharge to include 6-hour grabs during the period of discharge.
3. Language was added to E.6 to define a sampling day.
4. Language was added to E.7 stating that compliance at Location C will be determined only on parameters listed in 4.C.

May 9, 2003

5. Language was added to E.8-10 to clarify how composite and grab samples are to be collected.

We envision issuing the final permit by the end of next week.

If you have any questions, please call me at 337-1710.

Sincerely,



Jerry G. Richardson II  
Pretreatment Coordinator

enclosure

VILLAGE OF SAUGET

**DRAFT**

**AMERICAN BOTTOMS REGIONAL  
WASTEWATER TREATMENT FACILITY**

**WASTEWATER DISCHARGE PERMIT**

**for**

**SOLUTIA, INC. - Site R**

**PERMIT NO. 03-138**

DRAFT

Permit No. 03-138

Solutia, Inc.

Site R - Temporary Discharge

VILLAGE OF SAUGET

AMERICAN BOTTOMS REGIONAL WASTEWATER TREATMENT FACILITY

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DRAFT

May 9, 2003

Solutia, Inc. - W.G. Krummrich Plant - Site R - Temporary  
Discharge

500 Monsanto Avenue  
Sauget, Illinois 62206-1198

Wastewater Discharge Permit No. 03-138

Dear Sirs:

In accordance with all the terms and conditions of Ordinance 632 of the Village of Sauget; the 1977 Regional Agreement as amended; Section 46 of the Illinois Environmental Protection Act of 1970 (Ill. Rev. Stat. 1987. Ch. 1111/2, Sec. 1046) as amended; and Ill. Rev. Stat. 1987, Ch 24, Sec. 11-141-7; permission is hereby granted to Solutia Inc., to discharge treated groundwater into sewer lines tributary to the American Bottoms Regional Wastewater Treatment Plant in accordance with and subject to the provisions of attached American Bottoms Regional Wastewater Discharge Permit No. 03-138 ("Permit").

This Permit is granted in response to the application filed on January 28, 2003 in the office of the General Manager, #1 American Bottoms Road, Sauget, Illinois 62201, and in conformity with plans, specifications and other data submitted in support of the above application, all of which are filed with and considered as a part of this Permit, together with the attached conditions and requirements.

Nothing herein shall be construed as a permit or as permission for the permittee to violate the provisions of any sewer use ordinance in effect within the jurisdiction of any unit of local government in which the permittee's facility is located.

This Permit will take effect on May 15, 2003, and will expire on June 15, 2003.

VILLAGE OF SAUGET

By: \_\_\_\_\_  
General Manager

PART 1 - GENERAL CONDITIONS OF PERMIT

- A. General - This Wastewater Discharge Permit shall be expressly subject to all provisions of Ordinance 632 of the Village of Sauget, including any further amendments thereto (hereinafter "the Ordinance") and all other applicable regulations, user charges, and fees established by the Village of Sauget. In consideration of the granting of this Permit, the permittee shall comply with all provisions of the Ordinance, Permit conditions, and the Implementation procedures including, but not limited to the specific requirements of these General Condition Articles. Any Permit noncompliance constitutes a violation of the Ordinance, and is grounds for enforcement action.
- B. Prohibitive Standards - The permittee shall comply with all prohibitive discharge standards pursuant to Section 3.2 of the Ordinance and all Local, State, and Federal discharge limits set forth in the Permit.
- C. Prohibition of Improper Dilution - Improper dilution shall be prohibited pursuant to Section 3.6 of the Ordinance.
- D. Duration - This Permit is issued effective May 15, 2003, and shall expire on June 15, 2003.
- E. Transfer - Pursuant to Section 4.11 of the Ordinance, this Wastewater Discharge Permit may be reassigned or transferred, in whole or in part, to a new owner and/or operator only if the permittee gives at least thirty (30) days advance notice to the POTW and the POTW approves the Wastewater Discharge Permit transfer. The notice to the POTW must include a written certification by the new owner and/or operator which:
  - 1. States that the new owner and/or operator has no immediate intent to change the facility's operations and processes;
  - 2. Identifies the specific date on which the transfer is to occur; and
  - 3. Acknowledges full responsibility for complying with the Wastewater Discharge Permit.

- F. Change in Conditions - Pursuant to Section 4.7 of the Ordinance, in the event the type, quality, character or volume of Pollutants in a Discharge, including the listed or characteristic hazardous wastes for which the permittee has submitted initial notification under Section 4.13.5 of the Ordinance, is expected to substantially change as reasonably determined by the permittee or POTW, the permittee or his assignee (see paragraph E. above) shall give sixty (60) days advance notice in writing to the POTW and shall make a new application to the POTW and the Sewer System Owner prior to said change. No permittee shall substantially change the type, quality, character or volume of its Wastewater beyond that allowed by this Permit without prior approval of the Sewer System Owner and the POTW.
- G. Access - Pursuant to Section 4.15 of the Ordinance, persons or occupants of premises in which a Discharge source or treatment system is located or in which records are kept shall allow the POTW or its representative ready access upon presentation of credentials at reasonable times to all parts of said premises for the purposes of inspection, sampling, examination and photocopying of records required to be kept by the Ordinance and this Permit, and in the performance of any of their duties. The POTW shall have the right to set up on the permittee's property such devices as are necessary to conduct sampling, monitoring and metering operations.
- H. Retention of Records - Pursuant to Section 4.15 of the Ordinance, the permittee shall maintain records of all information resulting from any monitoring activities required by this Ordinance and shall include:
1. The date, exact place, method and time of sampling and the names of the Person or Persons taking the samples;
  2. The dates analyses were performed;
  3. Who performed the analyses;
  4. The analytical techniques/methods used; and
  5. The results of such analyses.

The permittee shall maintain for inspection by the POTW, IEPA or USEPA such records for a minimum of three (3) years.

This period of retention shall be extended during the course of any unresolved litigation regarding the Discharge of Pollutants by the permittee or operation of the POTW Pre-treatment program or when requested by the Regional Administrator of USEPA or the Director of IEPA.

- I. Analytical Methods - All measurements, sampling, tests, and analyses to which reference is made in this Permit shall be determined and performed in accordance with the procedures established by the Administrator of the United States Environmental Protection Agency (hereafter "Administrator") pursuant to Section 304(g) of the Act and contained in 40 CFR Part 136 and amendments thereto or with any other test procedures approved by the Administrator. Sampling shall be performed in accordance with the techniques approved by the Administrator. Where 40 CFR Part 136 does not include sampling or analytical techniques for the Pollutants in question, or where the Administrator determines that the Part 136 sampling and analytical techniques are inappropriate for the Pollutant in question, sampling and analyses shall be performed using validated analytical methods or any other sampling and analytical procedures, including procedures suggested by the POTW or other parties, approved by the Administrator.
- J. Pretreatment Facilities - The permittee shall provide necessary Wastewater Pretreatment as required to comply with the Ordinance and shall achieve compliance with all applicable Pretreatment Requirements and Standards within the time limitations as specified by appropriate statutes, regulations, and the Ordinance. Any facilities required to pretreat Wastewater to a level acceptable to the POTW shall be provided, properly operated and maintained at the permittee's expense. Such Pretreatment facilities shall be under the control and direction of an IEPA certified Wastewater Treatment Operator.
- K. Spill Containment - Pursuant to Section 3.7 of the Ordinance, any permittee having the ability to cause Interference or Pass-Through of the POTW or to violate the regulatory provisions of the Ordinance shall provide protection from Accidental or Slug Discharges to the POTW of prohibited materials or other substances regulated by the Ordinance. Any facilities required to prevent Accidental or Slug Dis-

charge of prohibited materials shall be provided and maintained at the permittee's own cost and expense.

- L. Permit Modifications - The terms and conditions of this Permit may be modified by the POTW during the term of the Permit for good cause including, but not limited to, the following: to incorporate any new or revised Federal, State, or local Pretreatment Standards or Requirements; to address significant alterations or additions to the permittee's operation, processes, or Wastewater volume or character since the time of Wastewater Discharge Permit issuance; a change in the POTW that requires either a temporary or permanent reduction or elimination of the authorized Discharge; misrepresentation or failure to fully disclose all relevant facts in the Wastewater Discharge Permit application or in any required reporting; revision of or a grant of variance from Categorical Pretreatment Standards pursuant to 40 CFR 403.13; to correct typographical errors in the Wastewater Discharge Permit; or to reflect a transfer of the facility ownership and/or operation to a new owner/operator (as provided in paragraph E. above). The permittee shall be informed of any proposed changes in its Permit at least 30 days prior to the effective date of any modification, and shall have all rights of appeal as provided in Section 4.12 of the Ordinance.
- M. Civil and Criminal Penalties - Pursuant to Part 6 of the Ordinance, any permittee who is found to have violated an Order of the POTW or who has failed to comply with any provision of the Ordinance, and the orders, rules, and regulations and Wastewater Discharge Permits issued thereunder, may be fined by appropriate suit at law in an amount not less than one hundred dollars (\$100) nor more than one thousand dollars (\$1000) per day for each violation. In addition to the penalties provided herein, the POTW may recover reasonable attorney's fees, court costs, court reporter fees and other expenses of litigation by appropriate suit at law against the Person found to have violated this Ordinance or the orders, rules, regulations and Permits issued thereunder.

Any Person who knowingly makes any false statements, representation or certification in any application, record, report, plan or other document filed or required to be

maintained pursuant to the Ordinance or Wastewater Discharge Permit, or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required under the Ordinance, shall in addition be guilty of a misdemeanor and upon conviction, be punished by a fine of \$500 to \$1,000, for each offense.

- N. Additional Information - The permittee shall furnish any additional information as may be reasonably requested by the Village of Sauget from time to time.
- O. Upset - The permittee shall have an affirmative defense for actions defined in Section 3.8 of the Ordinance. In any enforcement proceeding, the permittee seeking to establish the occurrence of an Upset shall have the burden of proof.
- P. Bypass - Bypass provisions pursuant to Section 3.9 of the Ordinance are applicable to this Permit and are hereby incorporated by reference.
- Q. Affirmative Defenses - The Permittee shall have an affirmative defense in any action brought against it alleging a violation of Section 3.2.1, 3.2.2.2, 3.2.2.4, 3.2.2.5, or 3.2.2.7.
- R. Resampling - Pursuant to Section 4.13.3.7 of the Ordinance, if sampling performed by the permittee indicates a violation, the permittee shall notify the POTW within 24 hours of becoming aware of the violation. The permittee shall also repeat the sampling and analysis and submit the results of the repeat analysis to the POTW within 30 days after becoming aware of the violation, except the permittee is not required to resample if:
  - 1. The POTW performs sampling at the permittee at a frequency of at least once per month, or
  - 2. The POTW performs sampling at the permittee between the time when the permittee performs its initial sampling and the time when the permittee receives the results of this sampling.
  - 3. The POTW may waive the resampling requirements if the SIU performs compliance self-monitoring at a frequency of at least once per month.

Resampling is only required for those parameters for which the violation has been identified.

S. Notifications - The following verbal and written notifications are required:

1. Pursuant to Section 4.13.3.7 of the Ordinance, if sampling performed by the permittee indicates a violation of any requirements of the Ordinance or this Permit, the permittee shall notify the POTW within 24 hours of becoming aware of the violation. Such notification may be made orally by telephone.
2. Pursuant to Section 3.7.4 of the Ordinance, in the case of an Accidental or Slug Discharge of Pollutants which may cause Interference at the POTW or may Pass Through the POTW or violate any other requirements of the Ordinance or this Permit, it shall be the responsibility of the permittee to immediately telephone and notify the POTW and the Sewer System Owner of the incident. The notification shall include name of caller, location and time of Discharge, type of Wastewater, estimated concentration and volume. For permittees discharging to the P-Chem Plant, notice to the POTW only is required.
3. Within five days following an Accidental Discharge, the permittee shall submit to the POTW and the Sewer System Owner a detailed written report describing the cause of the Accidental Discharge and the measures to be taken by the permittee to prevent similar future occurrences.
4. A permittee wishing to establish the affirmative defense of Upset for noncompliance with National Categorical Pre-treatment Standards shall, in addition to the 24-hour verbal notification required in 1. above, and under Section 3.8.3.3 of the Ordinance, provide a written submission containing the information required by Section 3.8.3.3 of the Ordinance within five days of becoming aware of the Upset.
5. Pursuant to Section 3.9.2.1 of the Ordinance, if the permittee knows in advance of the need for a Bypass, it shall submit prior written notice to the POTW, if possible at least ten days before the date of the Bypass.

**DRAFT**

Permit No. 03-138

Site R - Temporary Discharge - Solutia, Inc.

6. Pursuant to Section 3.9.2.2 of the Ordinance, the permittee shall submit oral notice to the POTW of an unanticipated Bypass that exceeds applicable Pretreatment Standards or Requirements to the POTW within 24 hours from the time the permittee becomes aware of the Bypass. A written submission meeting the requirements of Section 3.9.2.2 of the Ordinance shall also be provided to the POTW within 5 days of the time the permittee becomes aware of the Bypass.

7. Pursuant to Section 4.13.5.3 of the Ordinance, in the case of any new regulations under Section 3001 of RCRA identifying additional characteristics of hazardous waste or listing any additional substance as a hazardous waste, the permittee must notify the POTW, the EPA Regional Waste Management Division Director, and the State hazardous waste authorities of the Discharge of such substance within 90 days of the effective date of such regulations.

T. Report Submittal - All reports and/or notifications required by this Permit shall be submitted to:

Pretreatment Coordinator  
American Bottoms Regional Wastewater  
Treatment Facility  
#1 American Bottoms Road  
Sauget, Illinois 62201  
Telephone: (618) 337-1710  
Facsimile: (618) 337-8919

U. Revocation of Permit Pursuant to Section 5.3 of the Ordinance, this Permit may be revoked by the POTW for violations as identified in Section 5.3.1 of the Ordinance, and in accordance with the procedures set forth in Section 5.3.2 of the Ordinance.

V. Rate Ordinance: The Significant Industrial User to which this permit is issued is subject to the following Rate Ordinance(s) of the Village of Sauget:

1. Ordinance No. 536, as amended, which establishes user charges for the American Bottoms Regional Wastewater Treatment Facility.
2. Ordinance No. 596, as amended, which regulates the disposal of sewage, industrial wastes and other wastewater into and the use of the public sewage system served by the American Bottoms Regional Wastewater Treatment Facility.
3. Ordinance No. 380, as amended, which establishes user charges for the Village of Sauget Physical-Chemical Wastewater Treatment Plant.

#### PART 2 - GENERAL AND SPECIFIC REPORTING REQUIREMENTS

A. General - The General Pretreatment Regulations of 40 CFR 403.12 and Ordinance 632 have set forth basic reporting requirements that apply to the permittee.

B. Specific - The specific reporting requirements of this Permit include the following reporting requirements:

1. Monitoring Reports - Monitoring results obtained shall be summarized and reported on a monthly basis. Except as otherwise provided in Part 6 of the Permit, the report is due on or before 45 days after the end of the month in which the sampling was performed. The report shall indicate the nature and concentration of all pollutants in the wastewater discharges which are regulated by the standards set forth in this Permit and include measured or estimated maximum and average daily flows. These reports will satisfy the requirement for the Periodic Compliance Report, provided they contain all the information and certifications required pursuant to Section 4.13.3 of the Ordinance.

2. Compliance Deadline Report - Pursuant to Section 4.13.2 of the Ordinance, within ninety (90) days following the date for final compliance with any applicable Pretreatment Standards, or in the case of a New Source, within ninety (90) days following commencement of the Discharge of Wastewater into the POTW, any permittee subject to any Pretreatment Standards shall submit a report on compliance with any applicable Pretreatment Standards in a form prescribed and furnished by the POTW. This report shall con-

tain information as described in Section 4.13.2.2 of the Ordinance.

**PART 3 - GENERAL SAMPLING AND TESTING REQUIREMENTS**

- A. The permittee is responsible for compliance sampling. The monitoring facilities designated by this Permit are shown on Figure 1.
- B. Compliance monitoring results and frequencies may be reviewed periodically by the Village of Sauget and appropriate adjustments made to frequencies and parameters in a modified or revised Wastewater Discharge Permit.
- C. All handling and preservation of collected samples and laboratory analyses shall be performed in accordance with procedures contained in 40 CFR Part 136 and amendments thereto unless specified otherwise in the monitoring conditions of this Permit. Composite sampling, where called for, shall be performed over a twenty-four (24) hour period by flow or time proportionate methods.

The test procedures for all samples shall conform to one of the USEPA approved test methods which provides the most sensitive detection limits for the pollutant under investigation listed in the current issue of the Code of Federal Regulations, and the most recent addendum published by the Federal Register. The testing for priority organic pollutants shall be conducted utilizing gas chromatograph/mass spectrometer (GC/MS) methods and procedures. Other test procedures may be approved by the USEPA, pursuant to Section 4.15.2 of the Ordinance.

If more than one method for analysis of a substance is approved for use, a method having a detection limit lower than the permit limit shall be used. If the detection limit of all methods is higher than the permit limit, the method having the lowest detection limit shall be used and a report of less than detection limit shall constitute compliance. However should EPA approve a method with a lower detection limit during the term of this permit, the permittee shall use the newly approved method.

- D. The appropriate flow measurement devices and methods consistent with approved scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that

the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes.

- E. For each measurement or sample taken pursuant to the requirements of this Permit, the permittee shall maintain and submit records which include:
  1. The date, location, and type of sample collected;
  2. The dates analyses were performed;
  3. The analytical techniques/methods used;
  4. The results of such analyses; and
  5. The average daily and maximum daily flows.
- F. In the event of a sampling failure, including, but not limited to, failure of sampling equipment, or sample damage, contamination, or breakage, sampling shall be repeated as soon as possible at all applicable required monitoring locations for those parameters for which the analysis of the original sample(s) was intended.
- G. The 30 day resampling requirement of Part 1.Q. of this Permit shall apply to all monitoring locations identified in this Permit. Where a violation of a plant mass limitation has occurred, all sites which contribute to the calculation of the plant mass shall be resampled concurrently. Only those parameters for which the violation has been identified are required to be analyzed as part of the resampling.
- H. Where agreed upon in advance by both parties, the POTW may perform monitoring and testing for a parameter(s) regulated by this permit and such POTW monitoring shall satisfy the self-monitoring requirement for the subject parameter(s).

PART 4 - EFFLUENT LIMITATIONS, SAMPLING AND TESTING REQUIREMENTS

A. Local Limits: The Village of Sauget reserves the right, in Ordinance 632 and as amended, to establish limitations or requirements on discharges to the wastewater disposal system if deemed necessary to comply with the objectives presented in Section 1.4 of the Ordinance.

<u>Parameter</u>	<u>Limitations</u>
Ammonia nitrogen	50 mg/L (24-hour composite) 75 mg/L (grab) 50 lb/day (Daily maximum mass)

Ammonia nitrogen mass in a discharge shall be determined by multiplying the daily flow volume times the 24-hour composite sample concentration times the appropriate conversion factor or, if a 24-hour composite sample is not available, times the Grab sample concentration, for the same day.

pH	For Users discharging to the P-Chem plant: Any wastewater having a pH which causes or significantly contributes to the pH of the P-Chem Plant effluent to be greater than pH 10.0
----	---

B. State Limits: These limits are stated in 35 Ill. Adm. Code Part 307. This Part 307 places restrictions on the types, concentrations, and quantities of contaminants which can be discharged into sewer systems in the State.

<u>Parameters</u>	<u>Monthly Average</u> (mg/L)	<u>Daily Composite</u> (mg/L)	<u>Grab Sample</u> (mg/L)
Mercury	0.0005	0.001	0.0025
Cyanide (Total)	--	--	10.0

Any sample tested shall not release more than 2 mg/l of cyanide when tested at a pH of 4.5 and at a temperature of 66°C (150°F) for a period of 30 minutes.

Subject to the averaging rule of Ill Adm. Code 304.104, the monthly average for mercury shall be the numerical average of all daily composites for mercury taken during a calendar month. A monthly average must be based on at least three daily composites.

C. Site Specific Parameter Discharge Limits

<u>Parameter</u>	<u>Maximum Limit</u>	<u>Daily Sample Type</u>
Benzene	0.5 mg/l	Grab
Carbon tetrachloride	0.5 mg/l	Grab
Chlorobenzene	100 mg/l	Grab
Chloroform	6.0 mg/l	Grab
1,2-Dichloroethane	0.5 mg/l	Grab
1,2-Dichloroethylene	0.7 mg/l	Grab
Methyl ethyl ketone	200 mg/l	Grab
Tetrachloroethylene	0.7 mg/l	Grab
Trichloroethylene	0.5 mg/l	Grab
Vinyl chloride	0.2 mg/l	Grab
o-Cresol	200 mg/l	Comp
m-Cresol	200 mg/l	Comp
p-Cresol	200 mg/l	Comp
Cresol, total	200 mg/l	Comp
1,4-Dichlorobenzene	7.5 mg/l	Comp
2,4-Dinitrotoluene	0.13 mg/l	Comp
Hexachlorobenzene	0.1 lb/day	Comp
Hexachlorobutadiene	0.5 mg/l	Comp
Hexachloroethane	3.0 mg/l	Comp
Nitrobenzene	2.0 mg/l	Comp
Pentachlorophenol	10 lb/day	Comp
Pyridine	5.0 mg/l	Comp
2,4,5-Trichlorophenol	400 mg/l	Comp
2,4,6 Trichlorophenol	2.0 mg/l	Comp
Chlordane	0.02 lb/day	Comp
Endrin	0.02 lb/day	Comp
Heptachlor (and its epoxide)	0.02 lb/day	Comp
Lindane	0.02 lb/day	Comp
Methoxychlor	0.02 lb/day	Comp
Toxaphene	0.02 lb/day	Comp
2,4-D	0.02 lb/day	Comp
2,4,5-TP Silvex	0.02 lb/day	Comp
Arsenic	1.0 lb/day	Comp
Barium	100 lb/day	Comp
Cadmium	1.0 mg/l	Comp
Chromium	5.0 mg/l	Comp
Lead	5.0 mg/l	Comp
Mercury	0.2 mg/l	Comp
Selenium	1.0 mg/l	Comp
Silver	10.0 lb/day	Comp
2-Chloroaniline	monitoring only	Comp
4-Chloroaniline	monitoring only	Comp

Composite and Grab - See Part 4.E.8 and 9 below.

D. National Categorical Pretreatment Standards (NCPS):  
 Not Applicable

**E. Monitoring Schedule**

1. The monitoring schedule requirements are required as of the effective date of this Permit.

2. Monitoring locations are shown in the attached diagram - Figure 1, which is incorporated into and made a part of this Permit.

3. Monitoring frequencies:

Parameter (Units)	Monitoring Location	Monitoring Frequency	Sample Type
Ammonia nitrogen (mg/L)	C	See 4. below	Composite
Mercury (mg/L)	A, C	See 5. below	See 8. below
Cyanide (mg/L)	A, C	See 5. below	See 10. below
Flow (MGD)	C	Daily	Meter
Parameters per part 4.E.12	A, C	See 5. below	See 8. & 9. below
COD	A, B	See Part 6.C below	Grab

Monitoring Locations

A - Influent location before GAC treatment

B - Effluent of lead GAC column

C - Effluent location after GAC treatment

4. Compliance with the ammonia nitrogen local limit will be determined by testing performed by the POTW. Permittee self-monitoring for ammonia nitrogen is not required.

5. Monitoring frequency for the Permittee will be daily for the first, third, seventh day of discharge, and every seven days thereafter. The sample for first day of discharge shall include 6-hour grabs collected during the period of discharge.

6. A sampling day is 6am to 6am with the sample date designated as the date beginning the 24-hr period.

7. Compliance at Location C will be determined only on parameters listed in part 4.C above.

8. Daily composite samples for parameters other than volatile organic and cyanide shall consist of (4) four grab samples taken approximately every 6 hours. The individual grab samples shall be equally composited in the field or laboratory into one sample for analysis.

9. Grab samples for volatile organics shall consist of (4) four grab samples taken approximately every 6 hours in 40ml VOA septa lined containers without air bubbles. The

Site R - Temporary Discharge - Solutia, Inc.

individual 40ml VOA grabs shall be equally composited in the laboratory into one sample for analysis.

10. Grab samples for cyanide shall consist of a single grab sample collected during the sampling day.

11. All monitoring data shall be submitted no later than 45 days after the last day of discharge.

## 12. Pollutant Monitoring for Influent and Effluent.

Volatiles (ug/L)	Sample type	Base/Neutral (ug/L)	Sample Type	Base/Neutral Cont	Sample Type
Benzene	Grab	Acenaphthene	Comp	3-Nitrochloro	Comp
Bromoform	Grab	Acenaphthylene	Comp	benzene	
Carbon tetrachloride	Grab	Aniline	Comp	4-Nitroaniline	Comp
Chlorobenzene	Grab	Anthracene	Comp	4-Nitrochloro	Comp
Chlorodibromomethane	Grab	Benzidine	Comp	benzene	
Chloroethane	Grab	Benzo(a)anthracene	Comp	o-Cresol	Comp
Chloromethane	Grab	Benzo(a)pyrene	Comp	m-Cresol	Comp
2-chloroethylvinyl ether	Grab	3,4-benzofluoranthene	Comp	p-Cresol	Comp
Chloroform	Grab	benzo(ghi)perylene	Comp		
Dichlorobromomethane	Grab	benzo(k)fluoranthene	Comp	H.M. Pesticides (ug/L)	
1,1-dichloroethane	Grab	benzoic acid	Comp	Aldrin	Comp
1,2-dichloroethane	Grab	benzyl alcohol	Comp	Alpha-BHC	Comp
1,1-dichloroethylene	Grab	bis(2-chloroethoxy)methane	Comp	Beta-BHC	Comp
1,2-dichloropropane	Grab	bis(2-chloroethyl)ether	Comp	Gamma-BHC	Comp
1,3-dichloropropylene	Grab	bis(2-chloroisopropyl)ether	Comp	Delta-BHC	Comp
ethylbenzene	Grab	bis(2-ethylhexyl)phthalate	Comp	Chlordane	Comp
methyl bromide	Grab	4-bromophenyl phenyl ether	Comp	2,4 - D	Comp
methyl chloride	Grab	butylbenzyl phthalate	Comp	2,4,5-TP Silvex	Comp
methylene chloride	Grab	2-chloronaphthalene	Comp	4,4'-DDT	Comp
methyl ethyl ketone	Grab	4-chlorophenyl phenyl ether	Comp	4,4'-DDE	Comp
1,1,2,2-tetrachloroethane	Grab	chrysene	Comp	4,4'-DDD	Comp
tetrachloroethylene	Grab	dibenzo(a,h)anthracene	Comp	dielrin	Comp
toluene	Grab	1,2-dichlorobenzene	Comp	alpha-endosulfan	Comp
1,2-trans-dichloroethylene	Grab	1,3-dichlorobenzene	Comp	beta-endosulfan	Comp
1,1,1-trichloroethane	Grab	1,4-dichlorobenzene	Comp	endosulfan	Comp
1,1,2-trichloroethane	Grab	3,3'-dichlorobenzidine	Comp	sulfate	
trichloroethylene	Grab	diethyl phthalate	Comp	endrin	Comp
vinyl chloride	Grab	dimethyl phthalate	Comp	endrin aldehyde	Comp
xylenes	Grab	di-n-butyl phthalate	Comp	heptachlor	Comp
4-methyl-2-pentanone	Grab	2,4-dinitrotoluene	Comp	heptachlor	Comp
		2,6-dinitrotoluene	Comp	epoxide	
		di-n-octyl phthalate	Comp	methoxychlore	Comp
		1,2-diphenylhydrazine (as azobenzene)	Comp	PCB-1242	Comp
		fluoranthene	Comp	PCB-1254	Comp
Acid Compounds (ug/L)		fluorene	Comp	PCB-1221	Comp
2-chlorophenol	Comp	hexachlorobenzene	Comp	PCB-1232	Comp
2,4-dichlorophenol	Comp	hexachlorobutadiene	Comp	PCB-1248	Comp
2,4-dimethylphenol	Comp	hexachlorocyclopentadiene	Comp	PCB-1260	Comp
4,6-dinitro-o-cresol	Comp	hexachloroethane	Comp	PCB-1016	Comp
2,4-dinitrophenol	Comp	indeno(1,2,3,-cd)pyrene	Comp	toxaphene	Comp
2-nitrophenol	Comp	isophorone	Comp		
4-nitrophenol	Comp	naphthalene	Comp	Metals (mg/L)	
p-chloro-m-cresol	Comp	nitrobenzene	Comp	Arsenic, total	Comp
pentachlorophenol	Comp	N-nitrosodimethylamine	Comp	Barium, total	Comp
phenol	Comp	N-notrosodi-n-propylamine	Comp	Cadmium, total	Comp
2,4,5-trichlorophenol	Comp	N-notrosodiphenylamine	Comp	Chromium, total	Comp
2,4,6-trichlorophenol	Comp	Phenanthrene	Comp	Copper, total	Comp
4-Nitrophenolamine	Comp	Pyridine	Comp	Lead, total	Comp
4-Chlorophenol	Comp	1,2,4-trichlorobenzene	Comp	Mercury, total	Comp
4-Chloro-3-methylphenol	Comp	2-chloroaniline	Comp	Nickel, total	Comp
4-Chloro-2,6-dinitrophenol	Comp	4-chloroaniline	Comp	Selenium, total	Comp
		2-Nitroaniline	Comp	Silver, total	Comp
Composite and Grab -		2-Nitrochlorobenzene	Comp	Zinc, total	Comp
See Part 4.E.8, 9 & 10 above		3-Chloroaniline	Comp	Cyanide, total	Grab
				Iron, total	Comp

PART 5 - COMPLIANCE SCHEDULE

A. General:

Authority Citation: Section 4.13 Village of Sauget Pre-treatment Ordinance No. 632.

Permit No. 03-138

Industry Name: Solutia, Inc. - Site R

B. Final Compliance Date: Not applicable

PART 6 - SPECIAL CONDITIONS

- A. Cost of Service: Ordinance No. 632 (Pretreatment Ordinance) provides that the cost of the Pretreatment Program, including special sampling analysis, Monitoring, etc. be recovered from the customer causing the incurrence of the cost.

Separate billings are prepared regarding these costs and issued to the industries in the program. Monthly billings will be prepared for routine and special analytical services, and quarterly billing will be prepared for general and administrative costs. Payment is due within 21 days of billing.

- B. Prior commencement of construction, Solutia shall provide the POTW detailed construction drawings and plans of the discharge pipe showing where and how the discharge pipe to the P-Chem Plant is to be installed. The construction of the discharge pipe shall not commence prior to receipt of written authorization therefor by the POTW. Solutia shall also provide details as to the type, specifications and drawings of the flowmeters that are to be used. The selected flowmeters must be submitted to the Pretreatment Coordinator for review and approval prior to discharge.

- C. Breakthrough Monitoring: The permittee shall monitor for COD every 2 hours at the sampling ports of the lead carbon column influent and effluent to determine carbon breakthrough of the lead GAC column daily during discharge. Daily visual observations and COD results shall be recorded in a logbook that is maintained at the site.

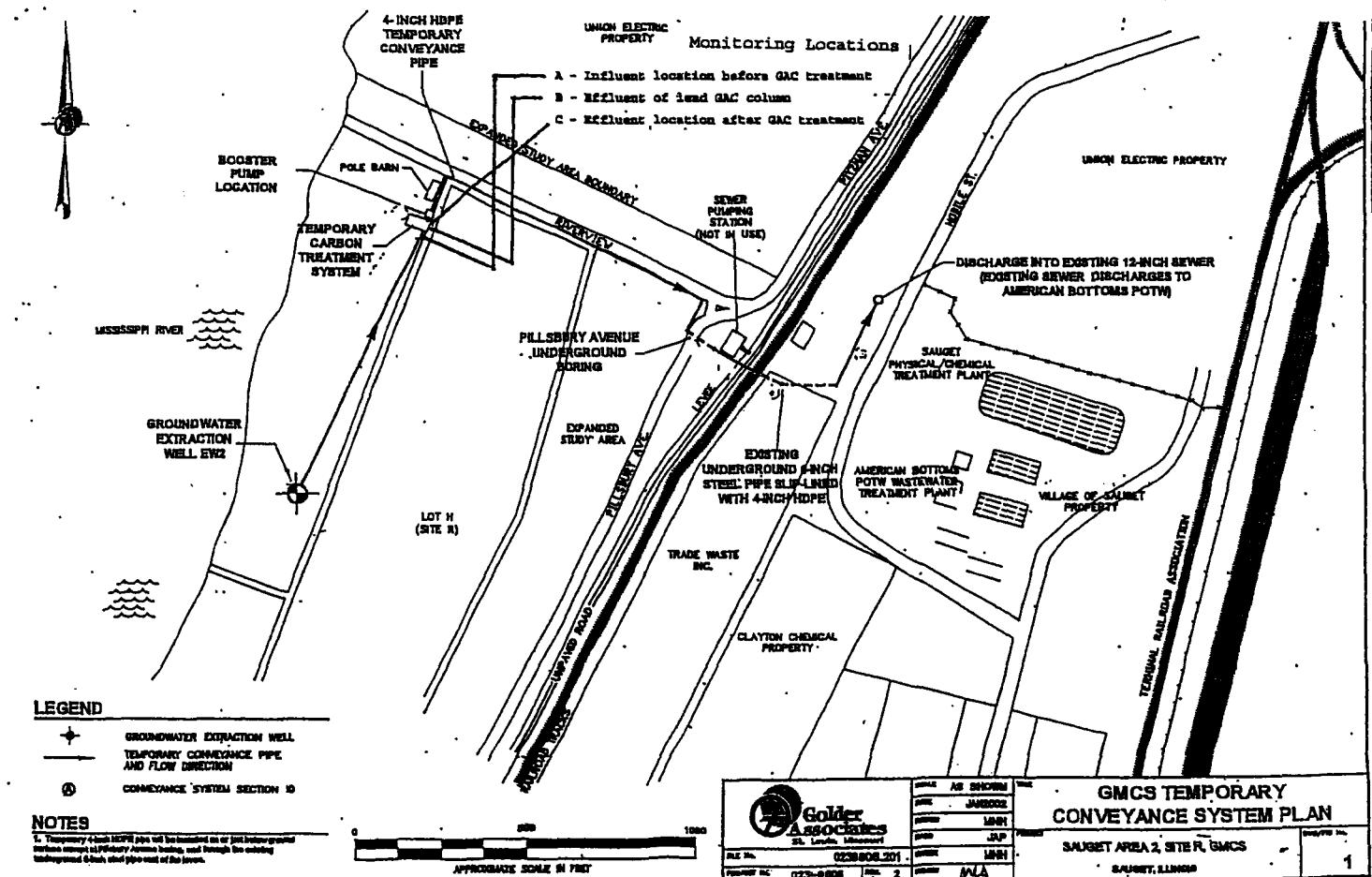
Immediate cessation of discharge shall occur upon detection of breakthrough in the carbon filters from COD results.

- D. Start-up/Shut-down of Pilot Treatment System: Solutia shall notify the American Bottoms Pretreatment Coordinator 24 hours prior to each start-up of discharge. Start-up shall only occur during weekdays between the hours of 6 am and 6 pm.
- Discharge from the Temporary Pilot Treatment System shall not resume once this Permit expires.
- E. Safety: Solutia shall operate under all proper safety measures during this temporary discharge permit that includes, but is not limited to installation of discharge pipe through the levee and immediate removal of discharge pipe from the levee if necessary.
- F. Discharge of hazardous waste as defined in 40 CFR 261.33 is expressly prohibited.
- G. The following certification statement shall be included in the self-monitoring report and signed by an authorized representative, "I certify that no hazardous waste, as defined in 40 CFR 261.33, has been discharged from this facility for this reporting period."
- H. Solutia shall remove the temporary discharge pipe that is between control structures 1 and 2 to P-Chem within 60-days following the expiration of this discharge permit.
- I. Discharge of untreated groundwater is strictly prohibited.

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Permit No. 03-138  
Solutia, Inc.  
Site R - Temporary Discharge

FIGURE 1 - MONITORING LOCATION





## **ATTACHMENT 2**

**ASTM METHOD D6586 - PERFORMING  
RAPID SMALL-SCALE COLUMN TEST**



## **Designation: D 6586 – 00**

# **Standard Practice for the Prediction of Contaminant Adsorption On GAC In Aqueous Systems Using Rapid Small-Scale Column Tests<sup>1</sup>**

This standard is issued under the fixed designation D 6586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval.

### **1. Scope**

- 1.1 This practice covers a test method for the evaluation of granular activated carbon (GAC) for the adsorption of soluble pollutants from water. This practice can be used to estimate the operating capacities of virgin and reactivated granular activated carbons. The results obtained from the small-scale column testing can be used to predict the adsorption of target compounds on GAC in a large column or full scale adsorber application.
- 1.2 This practice can be applied to all types of water including synthetically contaminated water (prepared by spiking high purity water with selected contaminants), potable waters, industrial waste waters, sanitary wastes and effluent waters.
- 1.3 This practice is useful for the determination of breakthrough curves for specific contaminants in water, the determination of the lengths of the adsorbates mass transfer zones (MTZ) and the prediction of GAC usage rates for larger scale adsorbers.
- 1.4 The following safety caveat applies to the procedure section, Section 10, of this practice: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### **2. Referenced Documents**

#### **2.1 ASTM Standards:**

- D 1129 Terminology Relating to Water<sup>2</sup>
- D 1193 Specifications for Reagent Water<sup>2</sup>
- D 2652 Terminology Relating to Activated Carbon<sup>3</sup>
- D 2854 Test Method Apparent Density of Activated Carbon<sup>3</sup>
- D 2867 Test Method Moisture Content of Activated Carbon<sup>3</sup>
- D 2862 Test Method Particle Size Distribution of Granular Activated Carbon<sup>3</sup>

### **3. Terminology**

#### **3.1 Definitions:**

- 3.1.1 For definitions of terms in this practice relating to activated carbon, refer to Terminology D 2652.
- 3.1.2 For definitions of terms in this practice relating to water, refer to Terminology D 1129.

### **4. Summary of Practice**

- 4.1 This practice consists of a method for the rapid determination of breakthrough curves and the prediction of GAC usage rates for the removal of soluble contaminants from water. This is accomplished by passing the contaminated water at a constant controlled rate down flow through a bed

of a specially sized granular activated carbon until predetermined levels of breakthrough have occurred.

- 4.2 When the assumption is made that conditions of constant diffusivity exist within the GAC column, the breakthrough data obtained from the column test can be used to estimate the size and operational conditions for a full-scale carbon adsorber.

## 5. Significance and Use

- 5.1 Granular activated carbon (GAC) is commonly used to remove contaminants from water. However if not used properly, GAC can not only be expensive but can at times be ineffective. The development of engineering data for the design of full-scale adsorbers often requires time-consuming and expensive pilot plant studies. This rapid standard practice has been developed to predict adsorption in large-scale adsorbers based upon results from small column testing. In contrast to pilot plant studies, the small-scale column test presented in this practice does not allow for a running evaluation of factors that may affect GAC performance over time. Such factors may include, for example, an increased removal of target compounds by bacterial colonizing GAC or long term fouling of GAC caused by inorganic compounds or background organic matters. Nevertheless, this practice offers more relevant operational data than isotherm testing without the principal drawbacks of pilot plant studies, namely time and expense; and unlike pilot plant studies, small scale studies can be performed in a laboratory using water sampled from a remote location.
- 5.2 This practice known as the rapid small-scale column test (RSSCT) uses empty bed contact time (EBCT) and hydraulic loading to describe the adsorption process. Mean carbon particle diameter is used to scale RSSCT results to predict the performance of a full-scale adsorber.
- 5.3 This practice can be used to compare the effectiveness of different activated carbons for the removal of contaminants from a common water stream.

## 6. Summary of Practice

- 6.1 The development of the RSSCT is based on the dispersed-flow pore surface diffusion model (DFPSDM) (Crittenden, et al<sup>6</sup>) which takes into account many of the mechanisms that are known to occur in fixed-bed adsorption. The following mechanisms, which cause the breakthrough curves for an adsorber to spread out and create the mass transfer zone are included in the DFPSDM: external mass-transfer resistance or film transfer, axial mixing due to dispersion and the internal mass-transfer resistances of pore and surface diffusion.
- 6.2 To simulate full-scale performance, the amount of spreading in the breakthrough curve relative to column depth must be identical for the RSSCT and the full-scale column. To achieve this, the relative contributions of the mechanisms that cause most of the spreading are matched by maintaining similarity as the GAC process is scaled. Crittenden et. al.<sup>6</sup> have shown that matching of the spreading of the breakthrough curve can be achieved by assuming intraparticle diffusivities are independent of the carbon particle radius, i.e. the condition of constant diffusivity. Under these conditions of constant diffusivity, the following equation describes the relationship between the small and large columns:

$$\frac{EBCT_{sc}}{EBCT_{lc}} = \frac{5}{|R_{sc}|} \left( \frac{|R_{sc}|}{|R_{lc}|} \right)^{\frac{1}{2}} \left( \frac{l_{sc}}{l_{lc}} \right)^{\frac{1}{2}}$$

(1)

where:  $EBCT_{sc}$  and  $EBCT_{lc}$  are the empty-bed contact times for the small-column (RSSCT) and the large-column (full-scale adsorber), respectively;  $R_{sc}$  and  $R_{lc}$  are the radii of the carbon particles used in the small and large columns, respectively; and  $t_{sc}$  and  $t_{lc}$  are the elapsed times required to conduct the small and large-column tests, respectively. The condition of constant diffusivity also requires the Reynolds numbers for the RSSCT and the large-column be equal. This means the following equation must also be satisfied:

$$\frac{V_{sc}}{V_{lc}} = \frac{5}{R_{lc}} \cdot \frac{R_{sc}}{R_{lc}} \quad (2)$$

where:  $V_{sc}$  and  $V_{lc}$  are the hydraulic loadings in the RSSCT and large columns, respectively. Based upon the above equations, the operating conditions for the RSSCT can be selected to precisely simulate the desired (specified) operating conditions for a full-scale adsorber. Note 1—Empty-bed contact time (EBCT) is defined as the volume (in liters) of carbon in the adsorber bed divided by the water flow rate in litres/minute. For example if a full scale adsorber holds 20 000 L of activated carbon and the water flow rate is 2500 L/min, the EBCT would be equal to 20 000/2500 or 8.0 min.

- 6.3 The assumption that conditions of constant diffusivity exist within the GAC column does not apply to all waters or all target compounds. For example this assumption does not apply for the decolorization of water and the adsorption of large molecules, such as humic acids. It is recommended that at least one RSSCT pilot-column comparison be conducted to aid in selecting the RSSCT design variables for a given water matrix (Crittenden, et al.). A detailed comparison between the constant diffusivity and proportional diffusivity approaches and their respective domains of application is beyond the scope of this practice.
- 6.4 GAC bed volume and preparation methods are important design parameters for the RSSCT. The GAC bed volume used will determine the required water pumping rate and affect the amount of water needed to complete the test. The minimum column diameter needed to avoid channeling and to minimize column head loss should be 50 particle diameters. For the 10-mm diameter column commonly used in RSSCT systems, a 60 by 80 mesh carbon should be used. Proper GAC sampling (Practice E 300) and preparation (grinding, classification and washing) are required for reproducible results.
- 6.5 Based upon the water feed rate to the column, the time required to reach the desired breakpoint and the weight of carbon used, GAC usage rates for treating the water can be calculated. Breakthrough curves for each contaminant being monitored during the column test can also be generated.

## 7. Interferences

- 7.1 Insoluble materials such as oils and greases, suspended solids, and emulsions will interfere with the adsorption of soluble materials by the GAC. Suspended solids in the column feed can lead to increased pressure drop and interfere with the operation of the column. These materials must be removed by suitable means before the water being treated is introduced to the column.
- 7.2 Air bubbles can interfere with water flow through the column and lead to misleading results. A means for removing air bubbles that are introduced into the system with the feed water should be incorporated to prevent these problems from occurring.

## 8. RSSCT Test Apparatus

- 8.1 The RSSCT test apparatus should be constructed of glass, PTFE and/or stainless steel, to minimize the adsorption of organic compounds. The apparatus shown in diagram form in Fig. 1 consists of a metering pump, inlet filter, pressure and flow indicators, up to three columns operating in series and

means for water sample collection and analysis.

- 8.1.1 *Glass columns*, vertically supported, 10.5 6 0.5 mm inside diameter and approximately 35 cm in length with threaded joints at both ends are most commonly used. Threaded PTFE end caps with seats for neoprene o-ring seals and tubing connectors should be provided at the top and bottom of the column for the admission and discharge of water. For operation at other than room temperature, a means for heating or cooling the columns and the water being treated should be established.
- 8.1.2 *GAC Support*—A column of fine glass wool installed to give a flat surface across the diameter of the column can be used for support of the GAC column. Alternatively the carbon bed can be supported on a 100-mesh stainless steel screen placed between two short sleeves made from 1.2in. PTFE tubing (see Fig. 2). The sleeves should be sized to fit tightly in the column to prevent any fluid from flowing between the sleeves and the column wall.
- 8.1.3 *Feed Pumps*—A liquid metering pump capable of maintaining a steady flow rate of 6 0.05 mL/min at a column back pressure of up to 100 psig should be used. To prevent over-pressurization of the column system in the event of column plugging during operation, the pump should be set up with a bypass loop that allows the discharge from the pump to be vented back to the pump inlet through an adjustable pressure relief device. The column inlet pressure and water flow rate should be monitored and recorded throughout the run.
- 8.1.4 *Water Filtration*—A filter to remove suspended solids that may be present in the water should be installed after the metering pump. A 47-mm inline filter housing with a 1.5 µm glass micro-fiber filter has been found to be adequate to remove suspended solids that may prematurely plug the carbon bed. Care must be exercised to ensure organic contaminants in the water being treated are not removed by the filter paper.
- 8.1.5 *Feed Water Containment*—The feed water should be maintained at the same temperatures as the carbon columns. If the feed water contains volatile organic compounds (VOCs), special care must be taken to prevent their loss during the test. For short duration column tests where a relatively small amount of water is to be treated, the feed water can be stored under zero head space conditions in pillow shaped bags manufactured from PTFE or similar material (typically used for the collection of gas samples). Gas sampling bags up to 100 L in volume can be conveniently used if properly supported. If larger volumes of water containing VOCs are to be treated, a 55-gal open top drum outfitted with a collapsible PTFE liner or other material that will prevent VOC loss, can be used. The liner is attached to the feed pump inlet tube and collapses as water is removed from the drum, thus always maintaining zero headspace conditions. Jacketed columns with temperature regulated circulation water can be used or the drum can be placed in a temperature-controlled cabinet if control of the feed water temperature is required.
- 8.1.6 *Sample Collection System*—Water effluent samples for analysis should be collected on a regular basis under zero headspace conditions. The collected samples should be refrigerated during collection or as soon as possible after collection to prevent degradation prior to analysis. The use of an automated sampler that is capable of collecting zero head space samples for extended unattended column tests has been found to be useful for sample collection and preservation. Water flow used in the collection of samples by means of the auto-sampler can be directed to a refrigerated container thus assuring the samples are maintained at cold temperatures during long duration sample collection. The size of the sample collected will be dependent on the type of analysis to be performed. Typically 35 mL vials with PTFE lined screw caps are used for sample collection. Larger water samples (up to 1 or 2 L) can be taken, but due to the low flow rates being used in the column test they will represent the operation of the column over an extended period of time.
- 8.1.7 *Alternative Column Feed System*—Fig. 3 shows an alternative feed system for the RSSCT. A spiked feed water containing a high concentration of the contaminants to be studied is contained in a zero headspace container as described in 8.1.5. This spiked feed is pumped at a slow rate and mixed with the source water. The flow rates of the two liquid metering pumps are adjusted to give the desired contaminant concentration in the column feed and at the same time the desired total column flow

rate to the columns. This setup allows for the easy study of the effect a particular water source matrix on the carbon's ability to adsorb different contaminants at different concentrations.

- 8.1.8 *Sample Analysis*—For column tests of extended duration, the samples collected using the auto-sampler should be analyzed in reverse order, that is, the last sample collected should be analyzed first. If the last sample collected does not indicate breakthrough, the earlier samples collected can be discarded. If breakthrough has occurred, the earlier samples can be analyzed to establish the exact time.

## 9. Reagents

9.1 *Granular Activated Carbon (GAC)*.

9.2 *Water, ASTM Type IV*.

## 10. Experimental Procedures

10.1 *Carbon Sample Preparations*—A representative sample of the GAC collected according to Test E 300 is crushed and screened to yield a 60 3 80-mesh fraction (Test Method D 2862). The screened carbon is thoroughly washed with water until all dust is removed and the pH of the wash water shows no significant change. The well-washed carbon is dried at 150°C for 4 h and stored in an amber colored bottle until it is ready for use.

10.2 *Column Loading*—The moisture content (Test Method D 2867) and apparent density (Test Method D 2854) of the test carbon are determined and recorded. A predetermined quantity of the 60 by 80-mesh carbon is weighed to 6 0.1 mg into a 100-mL beaker (see note). Approximately 40 mL of Type IV water is added to the carbon in the beaker and stirred. The carbon water slurry is heated to boiling for 10 min for the purpose of replacing the air in the carbon's pores with water. After cooling to room temperature, the entire sample of wet deaerated carbon is slurried into the column in such a way as to exclude air bubbles from the column. After loading, the settled height of the carbon column is recorded. Note 2—To determine quantity of carbon needed, first its volume is calculated from the EBCT for the column that is required to simulate the full-scale adsorber EBCT (see equation in 6.2), the water feed rate and the diameter of the column being used. Multiplying the volume of carbon by its apparent density will give the weight of carbon to be used.

10.3 *Water Feed Rate*—The water feed rate is determined by the empty bed contact time (EBCT) that is required to simulate specified operation in a large-scale adsorber. For example, using the quation from 6.2 and assuming that the  $EBCT_{lc}$  is 10 min for the full scale adsorber and  $R_{lc} = 0.0792\text{cm}$  (the average particle radius for an 8 by 30 mesh carbon) and the particle radius ( $R_{sc}$ ) for the 60 by 80 mesh carbon used in the column test is 0.0106 cm, the  $EBCT_{sc}$  time for the column test would be 0.179 min. The average particle radii for the 8 by 30 mesh and 60 by 80 mesh carbons is determined experimentally by measuring their respective mean particle size (Test Method D 2862). In that the volume of the small column (10 mm diameter by 18 cm in depth) to be used is 14.13 cm<sup>3</sup>, this example would require a water flow rate of 78.91 mL/min (14.13/0.179) to simulate the full-scale adsorber. The hydraulic loading for the above full-scale adsorber (assuming 10 ft diameter and a water flow rate of 260 gpm) would be 3.3 gpm/ft<sup>2</sup>(135 L/min/m<sup>2</sup>). For the RSSCT the hydraulic loading would be 24.7 gpm/ft<sup>2</sup> (1006 L/min/m<sup>2</sup>). Eq 2 states the ratio of the hydraulic loadings for the small column to that of the large column should be the same as the ratio of the carbon particle sizes used. Therefore for the condition of constant diffusivity to be satisfied, in this example 24.7/3.3 should equal 0.0792/0.0106.

Note 3—The average particle radius for the 60 by 80 mesh and 8 by 30 mesh carbons need to be determined experimentally as the magnitude of these values will significantly affect the calculated EBCT. The particle radius can be assumed to be equal to one-half the mean particle diameter as measured using Test Method D 2862.

10.4 *Column Operation*—It is often desirable to start the operation of the column(s) using high purity water as the feed. This will allow proper flow rates to be established and ensure there are no air bubbles in the system that will eventually find their way to the carbon column. Once flow rates have been

established, column feed is switched to the test water and the auto-sampler (if used) is actuated. The column(s) influent and effluent are sampled and analyzed periodically for the pollutants of interest. The frequency of the sampling will depend on the expected length of the run and the accuracy desired for the determination of the exact breakpoints. The column operation is continued until the effluent analysis equals the influent concentration or until other agreed upon pollutant concentrations are reached. If full breakthrough curves are developed for each contaminant, the length of the mass transfer zone (MTZ) for each compound of interest can be measured. The length of the MTZ can be estimated by first determining the ratio of the time required to go from 5 % breakthrough to 95 % of full breakthrough and the time that has elapsed from the start of the column test to full breakthrough for the compound of interest. Multiplying this ratio by the length of the carbon column measured in centimeters gives the length of the MTZ in centimetres.

**10.5 Data Collection**—The following data is collected during column operation and through subsequent sample analysis and used for the performance predictions:

- 10.5.1 Carbon bed volume,
- 10.5.2 Carbon mass used,
- 10.5.3 Feed water flow rate,
- 10.5.4 RSSCT EBCT,
- 10.5.5 Time to specified breakthrough for each contaminant of interest, and
- 10.5.6 Time to full breakthrough for each contaminant of interest (If Determined).

## **11. Calculation**

11.1 Using data collected from the analysis of the influent and effluent samples and column operating parameters, the following can be calculated:

11.1.1 *RSSCT Bed Life* = Time in minutes to specified breakthrough level

11.1.2 *Treatable Bed Volumes* = RSSCT Bed Life/RSSCT EBCT

11.1.3 *Total Volume of Water Fed to RSSCT Until Breakthrough* = RSSCT bed life by water flow rate,

11.1.4 *Specific Throughput* = Total Volume Fed to RSSCT/ Carbon Mass

11.1.5 *Carbon Usage Rate* = 1/Specific Throughput

11.1.6 *Length of MTZ*:

~time to 95 % of full BT! – ~time to 5 % BT!

~time to 95 % of Full BT! 3 L (3)

where:  $L$  = column length.

## **12. Precision and Bias**

12.1 The precision of this practice is limited both by the precision of the standard practices used in determining the concentration of the constituents and the precision of the determination of the exact breakthrough time for each constituent.

12.2 The bias of this practice is limited by the bias of the test methods used in determining the concentration of the constituents and the bias in the determination of the exact breakthrough time for each constituent.

### **13. Keywords**

#### **13.1 activated carbon; column testing; granular activated carbon; RSSCT**

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